UNT
UNIVERSITY
OF NORTH TEXAS®

SPECIFICATIONS

for

RENOVATIONS TO UNIVERSITY OF NORTH TEXAS

DISCOVERY PARK H WING RESEARCH LABS

UNIVERSITY OF NORTH TEXAS

DENTON, TEXAS

UNT PROJECT 14784

NOVEMBER 14, 2024

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SEALS PAGE

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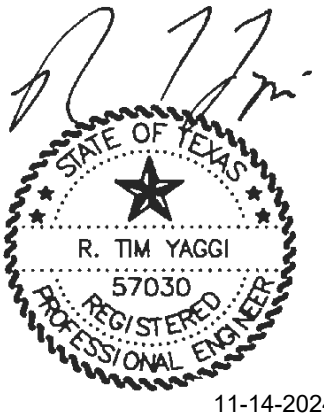

11-14-2024

ARCHITECT

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1106 W. Randol Mill Road, Suite 300
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Fort Worth, Texas 76116
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SECTION 011000

SUMMARY OF WORK

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. Phased construction
4. Work by Owner
5. Owner-furnished products
6. Access to site
7. Coordination with occupants
8. Work restrictions
9. Specification and drawing conventions
10. Special provisions
11. Purpose of Division 1 – General Requirements

1.3 PROJECT INFORMATION

A. Owner: University of North Texas System
B. Project Identification: Renovations to UNT Discovery Park H Wing Research Labs
C. Project Location: Denton, Texas
1. Owner's Construction Manager
2. Owner's Designated Representative
D. Architect: Yaggi Engineering, Inc.
E. Contractor
1. Construction Manager for this Project is Project's constructor. In Divisions 01 through 49 Sections, the terms "Construction Manager" and "Contractor" are synonymous.
1.
F. Project Web Site: A Project Web site administered by the Contractor will be used for purposes of managing communication and documents during the construction stage.
1. See Division 01 Section 013100 "Project Management and Coordination" for Contractor's requirements for utilizing the Project Web site.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of the Project is defined by the Contract Documents and consists of the following:
1. Renovations to UNT Discovery Park H Wing Research Labs.
B. Type of Contract
1. Project will be constructed under a Competitive Sealed Proposal contract.

1.5 PHASED CONSTRUCTION

A. The Work shall be conducted in phases, with each phase substantially complete as indicated:
1. Phase Designation : Brief Phase Description. Work of this phase shall commence within ( ) days after the Notice to Proceed and be substantially complete and ready for occupancy within ( ) days after the Notice to Proceed.
2. Phase Designation : The remaining Work shall be substantially complete and ready for occupancy at time of Substantial Completion for the Work.
B. Before commencing Work of each phase, submit an updated copy of the Contractor's construction schedule showing the sequence, commencement and completion dates [and move-out and -in dates of Owner's personnel] for all phases of the Work.

1.6 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.

B. Fees Paid by Owner: Impact Fees.
C. Fees Reimbursed by Owner: Tap Fees and Meter Fees.

1.7 ACCESS TO SITE

A. Use of Site: Limit use of Project site to [work in areas] [areas within the Contract limits] indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated. Use of any area outside of work area must be approved by Owner.
B. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weather-tight condition throughout construction period. Repair damage caused by construction operations to equal or better condition.

1.8 COORDINATION WITH OCCUPANTS

A. Full Owner Occupancy: Owner will occupy site and existing building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.
   1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
   2. Notify the Owner not less than three (3) days in advance of activities that will affect Owner's operations.
B. [Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.
   1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
   2. Provide not less than three (3) day notice to Owner of activities that will affect Owner's operations.]

1.9 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.
   1. Comply with limitations on use of public streets and other requirements of authorities having jurisdiction.
B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 7:00 a.m. to 5:00 p.m., Monday through Friday, except as otherwise indicated.
   1. Hours for Utility Shutdowns: Coordinated with Owner, with not less than two (2) weeks written notice of intended shutdown.
   2. Hours for core drilling and other noisy activities:
C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
   1. Notify Owner not less than three (3) days in advance of proposed utility interruptions.
   2. Obtain Owner's written permission before proceeding with utility interruptions.
D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
   1. Notify Owner not less than three (3) days in advance of proposed disruptive operations.
   2. Obtain Owner's written permission before proceeding with disruptive operations.
E. Nonsmoking Campus: Smoking is not permitted anywhere on any UNT campus.
F. Employee Identification: Provide identification tags for Contractor personnel working on the Project site. Require personnel to utilize identification tags at all times.

1.10 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 the Drawings are described in detail in the Specifications. One or more of the following are used on the 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.

1.11 SPECIAL PROVISIONS

A. Review Owner's tree protection and mitigation policy (Denton Campus ONLY) available at http://policy.unt.edu/policy/8-6.
Review Owner's Campus Design Guidelines (Denton ONLY) available at https://facilities.unt.edu/images/unt_design_and_construction_standards_2024_09.pdf

1.12 DIVISION 1 – GENERAL REQUIREMENTS

A. The specification sections contained with Division 01 – General Requirements, serve to expand and define in more detail, the administrative and procedural requirements outlined in Section 007000 – General Conditions. Should any provisions with Division 01 sections be in conflict with the General Conditions, the General Conditions shall govern.

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.
   1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when direction will be provided to the Contractor. If necessary, additional requirements will be issued by Change Order.

B. Types of allowances include the following:
   1. Lump sum allowances
   2. Unit cost allowances
   3. Quantity allowances

1.3 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, advise Design Professional and Owner 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 Design Professional’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 Design Professional from the designated supplier.

1.4 SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances.

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

C. 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.

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

1.5 COORDINATION

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

1.6 LUMP SUM, UNIT COST AND QUANTITY ALLOWANCES

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

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

C. 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 Design Professional, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.7 ADJUSTMENT OF ALLOWANCES

A. Allowance Adjustment: Should Owner determine that an adjustment is needed in an allowance amount; a Change Order will be prepared 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. Include installation costs in purchase amount only where indicated as part of the allowance.
   2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.

3. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to unit cost allowances.
4. 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. Allowance No. : Lump Sum Unit Cost Quantity Contingency Testing and Inspecting Allowance: Include the sum of [Insert dollar or quantity amount of allowance] : Include [Insert allowance description] as specified in Division [Insert Division number] Section " [Insert Section title] " and as shown on Drawings.
1. This allowance includes material cost, receiving, handling, and installation, and Contractor overhead and profit .
2. Coordinate quantity allowance adjustment with corresponding unit price requirements of Division 01 Section "Unit Prices."

END OF SECTION

SECTION 012200

UNIT PRICES

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 unit prices.

1.3 DEFINITIONS

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

1.4 PROCEDURES

A. Unit prices include all necessary material, cost for delivery, installation, insurance, overhead, and profit.

B. Measurement and Payment: Refer to individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

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

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

A. Unit Price No. - Insert unit price item :

1. Description: Insert unit-price item description according to Division Section , " Title ".
2. Unit of Measurement:
3. Quantity Allowance: Coordinate unit price with allowance adjustment requirements of Division 01 Section 012100, “Allowances".

END OF SECTION

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 Contractor 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: Modify 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 modifications 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

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. : Insert Title .
   1. Base Bid: Insert brief description of base bid requirement as indicated on Sheet Title and as specified in Division Section , " Title ".
   2. Alternate: Insert brief description of alternate requirement as indicated on Sheet Title and as specified in Division Section , “ Title ".

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 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

1.3 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.

1.4 SUBMITTALS

A. Substitution Requests: Submit one (1) PDF file 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 CSI Form 012500.13
   2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
      a. Statement indicating why specified product, fabrication, or installation cannot be provided, if applicable.
      b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, which 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.
      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. Design Professional's Action: If necessary, Design Professional will request additional information or documentation for evaluation within seven (7) days of receipt of a request for substitution. Design

Professional will notify Contractor of acceptance or rejection of proposed substitution within fifteen (15) days of receipt of request, or seven (7) days of receipt of additional information or documentation, whichever is later.

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

1.5 QUALITY ASSURANCE

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

1.6 PROCEDURES

A. Coordination: Modify 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 upon discovery of need for change, but not later than fifteen (15) days prior to time required for preparation and review of related submittals.
   1. Conditions: Design Professional 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.
      h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Not allowed, unless otherwise indicated. If allowed Design Professional will consider requests for substitution if received within sixty (60) days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Design Professional.
   1. Conditions: Design Professional will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Design Professional 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 Design Professional redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
      b. Requested substitution does not require extensive revisions to the Contract Documents.
      c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
      d. Substitution request is fully documented and properly submitted.
      e. Requested substitution will not adversely affect Contractor's construction schedule.
      f. Requested substitution has received necessary approvals of authorities having jurisdiction.
      g. Requested substitution is compatible with other portions of the Work.
      h. Requested substitution has been coordinated with other portions of the Work.
      i. Requested substitution provides specified warranty.
      j. 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 012500 “Substitution Procedures”:

1. SPECIFIED PRODUCT OR SYSTEM

Substitution request for: _____

Specification Section No.: _____ Article/ Paragraph: _____

2. REASON FOR SUBSTITUTION REQUEST

SPECIFIED PRODUCT	PROPOSED PRODUCT
☐ Is no longer available	☐ Will reduce construction time
☐ Is unable to meet project schedule	☐ Will result in cost savings of
☐ Is unsuitable for the designated application	$ _____ to Project
☐ Cannot interface with adjacent materials	☐ Is for supplier’s convenience
☐ Is not compatible with adjacent materials	☐ Is for subcontractor’s convenience
☐ Cannot provide the specified warranty	☐ Other: _____
☐ 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)

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 (3) 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: _____

PROJECT #3

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 Design Professional'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 Design Professional's approval, if granted, will be based upon reliance upon data submitted and the opinion, knowledge, information, and belief of the Design Professional at the time decision is rendered and Addendum is issued; and that Design Professional'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. DESIGN PROFESSIONAL'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: _____

Design Professional 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 for items not involving additional costs.

☐ Substitution is not accepted.

By: _____
(Owner's Construction Manager)

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 SUMMARY

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

B. Related Sections:

1. Division 01 Section 016000, "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

1.3 MINOR CHANGES IN THE WORK

A. Design Professional 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." or Architect's Bulletin form.

1.4 CHANGE ORDER REQUESTS

A. Owner/Design Professional-Initiated Change Order Requests: 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. Change Order Requests issued by Owner/Design Professional are not instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Change Order Request after receipt of Change Order 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.
    e. Quotation Form: Use Chang Order Request (COR) form. Contractor shall complete the COR Cost Analysis form and the Sub-Contractor shall submit the Sub-Contractor Cost Analysis form with supporting documentation and cost breakdown by line item, or other form approved by Owner.

B. Contractor-Initiated Change Orders: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Owner/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 Division 01 Section 012500, "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Change Order Request Form: Use Owner's standard Change Order Request form as approved by Owner and Design Professional.

1.5 ADMINISTRATIVE CHANGE ORDERS

A. Allowance Adjustment: Refer to Division 01, 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: Refer to Division 01 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.

1.6 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Change Order Request, Owner will prepare and issue a Change Order on attached form for signatures of Owner, Design Professional and Contractor.

1.7 CONSTRUCTION CHANGE DIRECTIVE

A. Work Change Directive: Owner may issue a Construction Change Directive on attached form. Construction Change 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 Work Change 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

CONSTRUCTION CHANGE ORDER

UNT SYSTEM

☐ **Construction Agreement**
☐ **JOC Job Order** **JO Date:**

FROM OWNER:
University of North Texas System
1155 Union Circle #311040
Denton, TX 76203

CHANGE ORDER NO.:
DATE:
CIP PROJECT NO.:
PO NO.:

TO CONTRACTOR: *(Name and Address)*

A/E NAME:
PROJECT/CONTRACT NO.:
CONTRACT DATE:
PROJECT NAME:

The Agreement is changed as follows:

Total	**$ -**

All Services provided per _____ attached are hereby incorporated by reference for all purposes.

The original Agreement, Early Release Packages, and/or GMP Amendment Sum:	
The net change by previously authorized Change Orders:	
The Agreement Sum prior to this Change Order:	$ -
The Agreement Sum will be increased by this Change Order in the amount of	$ -
New Agreement Sum including this Change Order:	**$ -**

The TIME of the project has increased by _____ **days**

The date of SUBSTANTIAL COMPLETION as of the date of this Change Order is _____

Or if services are being provided after SUBSTANTIAL COMPLETION
The completion date of the services provided in this Change Order will be _____

NOT VALID UNTIL SIGNED BY THE A/E, CONTRACTOR AND OWNER

A/E (*Firm Name*)	CONTRACTOR (*Firm Name*)	University of North Texas System OWNER
By (Signature)	By (Signature)	By (Signature)
Name (Typed or Printed Name)	Name (Typed or Printed Name)	Name (Typed or Printed Name)
Title	Title	Title
Date	Date	Date

Approved by UNTS OGC through 12/31/2021

Construction Change Directive

FROM OWNER:
University of North Texas (System or Institution)
1155 Union Circle #311040
Denton, Texas 76203

CONSTRUCTION CHANGE DIRECTIVE NUMBER:

DATE ISSUED: _____

TO CONTRACTOR: *(Name and Address)*

_____
_____
_____
_____

PROJECT NAME: _____
AGREEMENT DATE: _____
CIP PROJECT NUMBER _____
PURCHASE ORDER NUMBER: _____

The following change in the Contract Documents is approved by the Owner and the Work is authorized to proceed accordingly:

Additional Days Required [ ] Calendar Days

Not to Exceed Cost $ -

When the Owner and Contractor agree upon the exact adjustment in the Contract Price and/or the Contract Time for a change in the Work directed by this Construction Change Directive, such agreement shall be the subject of a Change Order.

The Change Order shall include all outstanding Construction Change Directives that the contractor would like to include on an application for payment.

A Change Order must be executed before the Contractor is allowed to add the Work described above on an application for payment.

Owner
University of North Texas (System or Institution Name)

BY *(Signature)*

[Authorized Signatory Name]
[Authorized Signatory Title]

Date

BY *(Signature)*

[Authorized Signatory Name]
[Authorized Signatory Title]

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 Specifications Sections apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Sections include the following:

1. Division 01 Section 012600 for administrative procedures for handling changes to the Contract.
2. Division 01 Section 013200 for administrative requirements governing preparation and submittal of Contractor's Construction Schedule and Submittal Schedule.
3. Division 00 Section 007000 – University of North Texas System Uniform General Conditions and Supplementary General Conditions 2022.

1.3 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 Application for Payment. The Schedule of Values is a form provided by Owner to Contractor

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule

1. Correlate line items in the Schedule of Values with other required administrative forms and schedules including the following:
    a. Application for Payment form with Continuation Sheets
2. Submit the Schedule of Values to Architect at earliest possible date but no later than seven calendar days before the date scheduled for submittal of initial Application for Payment.
3. Sub schedules: Where the Work is separated into phases requiring separately phased payments, provide sub-schedules indicating values correlated with each phase of payment.

B. Format and Content: Use the CIS Divisions 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. The Schedule of Values is formatted using CSI Divisions. (see form instructions)
3. Draft Submittals: Submit in same format as final payment application
4. Arrange the Schedule of Values in tabular form with separate sections to indicate the following for each item listed:
    a. Related Specification Section or Division
    b. Change Orders (numbers) that affect value
    c. Dollar value

1) Percentage of the Contract Sum to nearest one-tenth percent adjusted to total 100 percent.

5. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Owner/Architect will review Contractor's Schedule of Values and approve upon receipt of sufficient detail as deemed satisfactory to Owner/Architect.
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. Include evidence of insurance and storage in bonded warehousing for materials stored off-site.
   b. Major items include but not limited to:

- Division 01 - General Requirements
- Division 02 - Existing Conditions
- Division 03 - Concrete
- Division 04 - Masonry
- Division 05 - Metals
- Division 06 - Wood, Plastics, Composites
- Division 07 - Thermal and Moisture Protection
- Division 08 - Openings
- Division 09 - Finishes
- Division 10 - Specialties
- Division 11 - Equipment
- Division 12 - Furnishings
- Division 13 - Special Construction
- Division 14 - Conveying Equipment
- Division 21 - Fire Suppression
- Division 22 - Plumbing
- Division 23 - Heating, Ventilating, and Air Conditioning (HVAC)
- Division 25 - Integrated Automation
- Division 26 - Electrical
- Division 27 - Communications
- Division 28 - Electronic Safety and Security
- Division 31 - Earthwork
- Division 32 - Exterior Improvements
- Division 33 - Utilities
- Division 34 - Transportation
- Division 35 - Waterway and Marine Construction
- Division 40 - Process Integration
- Division 41 - Material Processing and Handling Equipment
- Division 42 - Process Heating, Cooling, and Drying Equipment
- Division 43 - Process Gas and Liquid Handling, Purification and Storage Equipment
- Division 44 - Pollution and Waste Control Equipment
- Division 45 - Industry-Specific Manufacturing Equipment
- Division 46 - Water and Wastewater Equipment
- Division 48 - Electrical Power Generation

7. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost.

8. In addition to line item costs of Sections in Division 02 thru 39, furnish line item costs for each item of the following general administrative and procedural cost items.
    a. Bonds
    b. Insurance
    c. Overhead and General Conditions
    d. Contractor's Fee
9. Plumbing, HVAC, Electrical and Life Safety work shall be broken down in accordance with the following subcategories as a minimum:
    a. Fire Protection:
    b. Plumbing:
    c. Heating, Ventilating and Air Conditioning (HVAC):
    d. Electrical:
    e. Fire Detection and Alarm:

1.5 APPLICATIONS FOR PAYMENT

A. Electronically deliver in a format approved by Owner after the Design Professional has certified the Payment Application Payment processing will start as soon as we receive

B. Each 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.

C. Payment Application Times: Progress payment is due once a month.

D. Payment Application Forms: Use Application for Payment form to be furnished by Owner.

E. Application Preparation: Complete every entry on form. Application to be Notarized by a Notary and executed 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 of Change Order issued before the last day of construction period covered by application.
    3. Include supporting documentation including subcontractor and supplier invoices.

F. Transmittal: Prepare one copy of each Application for Payment by a method ensuring receipt within 24-hours. The copy shall include waivers of lien, schedule updates, contractor's executive summary and similar attachments.
    1. Transmit each package with a transmittal form listing attachments and recording appropriate information about application including subcontractor supplemental documentation and required general conditions documents.

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

H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment.
    1. Include the following:
        a. List of subcontractors
        b. Schedule of Values

c. Contractor's Construction Schedule (preliminary if not final)
d. Products list
e. Submittal Schedule (preliminary if not final)
f. List of Contractor's staff assignments
g. List of Contractor's principal consultants
h. Initial progress report
i. Report of preconstruction conference
j. Certificates of insurance and insurance policies
k. Performance and payment bonds
l. Data needed to acquire Owner's insurance

I. Application for Payment at Substantial Completion: After issuing 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 Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

J. Final Payment Application: Submit Final Application for Payment within thirty (30) days of Substantial Completion along 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 certificate for products and completed operations where required and proof 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 G706A, "Contractor's Affidavit of Release of Liens"
6. AIA Document G707, "Consent of Surety to Final Payment"
7. Evidence that claims have been settled

K. Electronic Fund Transfer (EFT): Vendors are required to utilize EFT for the distribution of all future payments. To sign up for EFT, complete the a Payment Works profile (Supplier) at, https://help.paymentworks.com/contactsupport. Once established, all future payments will be made by EFT. When an EFT payment is made, an email will be sent to the email address you specify on the Payment Works profile. If you have any questions, please contact the Business Service Center at bsc@untsystem.edu or 940-369-5500.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

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 project coordination procedures
   2. Administrative and supervisory personnel
   3. Coordination drawings
   4. Requests for Information (RFIs)
   5. Project Web site
   6. Project meetings

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

1.3 DEFINITIONS

A. RFI: Request from Contractor seeking information from each other during construction.

1.4 COORDINATION

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
   1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
   2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
   3. Make adequate provisions to accommodate items scheduled for later installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
   1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
   1. Preparation of Contractor's construction schedule, continually updated, and in a format acceptable to Owner
   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. Pre-Installation conferences
   7. Project closeout activities
   8. Startup and adjustment of systems
   9. Project closeout activities

1.5 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings in accordance with requirements in individual Sections, 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. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
f. Indicate required installation sequences.
g. 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 Design Professional 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 sub-framing 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, including fire protection requirements.
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 1¼ -inch diameter and larger
   b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire alarm locations
   c. Panel board, switchboard, 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. Review: Design Professional will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are the Contractor's responsibility. If the Design Professional determines that the coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, the Design Professional will so inform the Contractor (copy the Owner), who shall make changes as directed and resubmit.
10. Coordination Drawing Prints: Prepare coordination drawing prints in accordance with requirements of Division 01 Section 013300, "Submittal Procedures".

C. Coordination Digital Data Files: Prepare coordination digital data files in accordance with the following requirements:
1. File Preparation Format: Same digital data software program, version, and operating system as the original Drawings.
2. File Preparation Format: DWG, Version, operating in Microsoft Windows operating system.
3. File Submittal Format: Submit or post coordination drawing files using Portable Data File (PDF) format.

4. Design Professional will furnish Contractor one set of digital data files of the Drawings for use in preparing coordination digital data files. Refer to Division 01 Section 013300, “Submittal Procedures”, for digital data file requirements.
    a. Design Professional makes no representations as to the accuracy or completeness of digital data files as they relate to the Drawings.
    b. Digital Data Software Program: The Drawings are available in [Program].
    c. Contractor shall execute a data licensing agreement in a form agreeable to the Design Professional.

1.6 CHANGE KEY PERSONNEL

A. Change Key Personnel Names: Changes to key personnel originally stated in the bid response must include a revised 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 email addresses. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
    1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.
    2. Key personnel must be same as those proposed in the bid response unless changes are authorized in writing from the Associate Vice Chancellor for System Facilities prior to their first day on the project.

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. All RFIs should be sent directly to the Design Professional via email or posted to project collaboration site (if one is being utilized). The Design Professional will redistribute to the appropriate reviewer.
    1. Design Professional will return RFIs submitted to Design Professional 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 Design Professional
    6. RFI number, numbered sequentially
    7. RFI subject
    8. RFI Question
    9. Specification Section number and title and related paragraphs, as appropriate
    10. Drawing number and detail references, as appropriate
    11. Field dimensions and conditions, as appropriate
    12. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
    13. Contractor's signature
    14. 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 Design Professional. RFIs should be emailed to Design Professional with the following format standards. 1) RFI should include RFI number in subject line of email along with brief description. 2) Body of email should include question or description of RFI and suggestion. Sketches or other necessary documents should be attached to email in PDF format.

D. Design Professional's Action: Design Professional will review each RFI, determine action required, and respond. Allow seven (7) business days for Design Professional's response for each RFI. RFIs received by Design Professional after 1:00 p.m. will be considered as received the following working day.
    1. The following RFIs will be returned without action:
        a. Requests for approval of submittals
        b. Requests for approval of substitutions
        c. Requests for coordination information already indicated in the Contract Documents
        d. Requests for adjustments in the Contract Time or the Contract Sum

e. Requests for interpretation of Design Professional's actions on submittals
f. Incomplete RFIs or inaccurately prepared RFIs

2. Design Professional's action may include a request for additional information, in which case Design Professional's time for response will date from time of receipt of additional information.
3. Design Professional'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 Division 01 Section 012600, "Contract Modification Procedures".
   a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Design Professional in writing within ten (10) days of receipt of the RFI response.

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

F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. log with not less than the following:
1. RFI Log Date
2. Project name
3. Name and address of Contractor
4. Name and address of Design Professional and Construction Manager
5. RFI number including RFIs that were dropped and not submitted
6. RFI description
7. Date the RFI was submitted
8. Request Date
9. Date Design Professional's and Construction Manager's response was received
10. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate
11. Identification of related Field Order, Work 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 Design Professional of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees in advance of meeting.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Design Professional, within three (3) days of the meeting.

B. Pre-construction Conference: Schedule and conduct a pre-construction conference before starting construction, at a time convenient to Owner and Design Professional, but no later than fifteen (15) days after notice to proceed.
1. Conduct the conference to review responsibilities and personnel assignments.
2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Construction Manager, Design Professional, 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. Agenda: Distribute the agenda to all invited attendees in advance of meeting. Discuss items of significance that could affect progress, including the following:
   a. Tentative construction schedule
   b. Phasing
   c. Critical work sequencing and long-lead items
   d. Designation of key personnel and their duties
   e. Lines of communications
   f. Procedures for processing field decisions and Change Orders
   g. Procedures for RFIs
   h. Procedures for testing and inspecting
   i. Procedures for processing Applications for Payment
   j. Distribution of the Contract Documents
   k. Submittal procedures
   l. Sustainable design requirements
   m. Preparation of record documents
   n. Use of the premises[and existing building]
   o. Work restrictions
   p. Working hours

q. Owner's occupancy requirements
r. Responsibility for temporary facilities and controls
s. Procedures for moisture and mold control
t. Procedures for disruptions and shutdowns
u. Construction waste management and recycling
v. Parking availability
w. Office, work, and storage areas
x. Equipment deliveries and priorities
y. First aid
z. Security
aa. Progress cleaning
bb. Commissioning requirements/coordination

4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes within three (3) days of meeting date.

C. Pre-Installation Conferences: Conduct a pre-installation 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 Design Professional of scheduled meeting dates.
2. Agenda: Distribute the agenda to all invited attendees in advance of meeting. Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
a. Contract Documents
b. Options
c. Related RFIs
d. Related Change Orders
e. Purchases
f. Deliveries
g. Submittals
h. Review of mockups
i. Possible conflicts
j. Compatibility problems
k. Time schedules
l. Weather limitations
m. Manufacturer's written recommendations
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. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes within three (3) days of meeting date.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Project Closeout Conference: Schedule and conduct Project closeout conference, at a time convenient to Owner and Design Professional, but no later than [number] 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, Design Professional, 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: Distribute the agenda to all invited attendees in advance of meeting. 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 preparing sustainable design documentation
   e. Requirements for preparing operations and maintenance data
   f. Requirements for demonstration and training
   g. Preparation of Contractor's punch list
   h. Procedures for processing Applications for Payment at Substantial Completion and for final payment
   i. Submittal procedures
   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 within three (3) days of meeting date.

E. Progress Meetings: Conduct progress meetings at agreed upon intervals.
1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner, Owner's Commissioning authority, Construction Manager, and Design Professional, each contractor, 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: Distribute the agenda to all invited attendees in advance of meeting. 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.
      Review schedule for next period.
   b. Review present and future needs of each entity present, including the following:
      Interface requirements
      Sequence of operations
      Status of submittals
      Deliveries
      Off-site fabrication
      Access
      Site utilization
      Temporary facilities and controls
      Progress cleaning
      Quality and work standards
      Status of correction of deficient items
      Field observations
      Status of RFIs
      Status of proposal requests
      Pending changes
      Status of Change Orders
      Pending claims and disputes
      Documentation of information for payment requests
      Recommendations of construction feasibility
      Safety precautions and programs

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information within three (3) days of meeting date.
   a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

F. Coordination Meetings: Conduct project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and pre-installation conferences.
   1. Attendees: In addition to representatives of Owner and Design Professional, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
   2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
      a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
      b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
      c. Review present and future needs of each contractor present, including the following:
         Interface requirements
         Sequence of operations
         Status of submittals
         Deliveries
         Off-site fabrication
         Access
         Site utilization
         Temporary facilities and controls
         Work hours
         Hazards and risks
         Progress cleaning
         Quality and work standards
         Change Orders
   3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting, within three (3) days of meeting date.
   4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes within three (3) days of meeting date.

G. Meetings Requested by Owner: While not necessarily coinciding with dates of other meetings, Owner reserves the right to call and conduct meetings with project participants as the need arises.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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 project coordination procedures
   2. Administrative and supervisory personnel
   3. Coordination drawings
   4. Requests for Information (RFIs)
   5. Project Web site
   6. Project meetings

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

1.3 DEFINITIONS

A. RFI: Request from Contractor seeking information from each other during construction.

1.4 COORDINATION

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
   1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
   2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
   3. Make adequate provisions to accommodate items scheduled for later installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
   1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
   1. Preparation of Contractor's construction schedule, continually updated, and in a format acceptable to Owner
   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. Pre-Installation conferences
   7. Project closeout activities
   8. Startup and adjustment of systems
   9. Project closeout activities

1.5 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings in accordance with requirements in individual Sections, 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. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
f. Indicate required installation sequences.
g. 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 Design Professional 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 sub-framing 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, including fire protection requirements.
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 1¼ -inch diameter and larger
   b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire alarm locations
   c. Panel board, switchboard, 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. Review: Design Professional will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are the Contractor's responsibility. If the Design Professional determines that the coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, the Design Professional will so inform the Contractor (copy the Owner), who shall make changes as directed and resubmit.
10. Coordination Drawing Prints: Prepare coordination drawing prints in accordance with requirements of Division 01 Section 013300, "Submittal Procedures".

C. Coordination Digital Data Files: Prepare coordination digital data files in accordance with the following requirements:
1. File Preparation Format: Same digital data software program, version, and operating system as the original Drawings.
2. File Preparation Format: DWG, Version, operating in Microsoft Windows operating system.
3. File Submittal Format: Submit or post coordination drawing files using Portable Data File (PDF) format.

4. Design Professional will furnish Contractor one set of digital data files of the Drawings for use in preparing coordination digital data files. Refer to Division 01 Section 013300, “Submittal Procedures”, for digital data file requirements.
    a. Design Professional makes no representations as to the accuracy or completeness of digital data files as they relate to the Drawings.
    b. Digital Data Software Program: The Drawings are available in [Program].
    c. Contractor shall execute a data licensing agreement in a form agreeable to the Design Professional.

1.6 CHANGE KEY PERSONNEL

A. Change Key Personnel Names: Changes to key personnel originally stated in the bid response must include a revised 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 email addresses. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
    1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.
    2. Key personnel must be same as those proposed in the bid response unless changes are authorized in writing from the Associate Vice Chancellor for System Facilities prior to their first day on the project.

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. All RFIs should be sent directly to the Design Professional via email or posted to project collaboration site (if one is being utilized). The Design Professional will redistribute to the appropriate reviewer.
    1. Design Professional will return RFIs submitted to Design Professional 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 Design Professional
    6. RFI number, numbered sequentially
    7. RFI subject
    8. RFI Question
    9. Specification Section number and title and related paragraphs, as appropriate
    10. Drawing number and detail references, as appropriate
    11. Field dimensions and conditions, as appropriate
    12. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
    13. Contractor's signature
    14. 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 Design Professional. RFIs should be emailed to Design Professional with the following format standards. 1) RFI should include RFI number in subject line of email along with brief description. 2) Body of email should include question or description of RFI and suggestion. Sketches or other necessary documents should be attached to email in PDF format.

D. Design Professional's Action: Design Professional will review each RFI, determine action required, and respond. Allow seven (7) business days for Design Professional's response for each RFI. RFIs received by Design Professional after 1:00 p.m. will be considered as received the following working day.
    1. The following RFIs will be returned without action:
        a. Requests for approval of submittals
        b. Requests for approval of substitutions
        c. Requests for coordination information already indicated in the Contract Documents
        d. Requests for adjustments in the Contract Time or the Contract Sum

e. Requests for interpretation of Design Professional's actions on submittals
f. Incomplete RFIs or inaccurately prepared RFIs

2. Design Professional's action may include a request for additional information, in which case Design Professional's time for response will date from time of receipt of additional information.
3. Design Professional'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 Division 01 Section 012600, "Contract Modification Procedures".
   a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Design Professional in writing within ten (10) days of receipt of the RFI response.

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

F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. log with not less than the following:
1. RFI Log Date
2. Project name
3. Name and address of Contractor
4. Name and address of Design Professional and Construction Manager
5. RFI number including RFIs that were dropped and not submitted
6. RFI description
7. Date the RFI was submitted
8. Request Date
9. Date Design Professional's and Construction Manager's response was received
10. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate
11. Identification of related Field Order, Work 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 Design Professional of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees in advance of meeting.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Design Professional, within three (3) days of the meeting.

B. Pre-construction Conference: Schedule and conduct a pre-construction conference before starting construction, at a time convenient to Owner and Design Professional, but no later than fifteen (15) days after notice to proceed.
1. Conduct the conference to review responsibilities and personnel assignments.
2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Construction Manager, Design Professional, 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. Agenda: Distribute the agenda to all invited attendees in advance of meeting. Discuss items of significance that could affect progress, including the following:
   a. Tentative construction schedule
   b. Phasing
   c. Critical work sequencing and long-lead items
   d. Designation of key personnel and their duties
   e. Lines of communications
   f. Procedures for processing field decisions and Change Orders
   g. Procedures for RFIs
   h. Procedures for testing and inspecting
   i. Procedures for processing Applications for Payment
   j. Distribution of the Contract Documents
   k. Submittal procedures
   l. Sustainable design requirements
   m. Preparation of record documents
   n. Use of the premises[and existing building]
   o. Work restrictions
   p. Working hours

q. Owner's occupancy requirements
r. Responsibility for temporary facilities and controls
s. Procedures for moisture and mold control
t. Procedures for disruptions and shutdowns
u. Construction waste management and recycling
v. Parking availability
w. Office, work, and storage areas
x. Equipment deliveries and priorities
y. First aid
z. Security
aa. Progress cleaning
bb. Commissioning requirements/coordination

4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes within three (3) days of meeting date.

C. Pre-Installation Conferences: Conduct a pre-installation 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 Design Professional of scheduled meeting dates.
2. Agenda: Distribute the agenda to all invited attendees in advance of meeting. Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
a. Contract Documents
b. Options
c. Related RFIs
d. Related Change Orders
e. Purchases
f. Deliveries
g. Submittals
h. Review of mockups
i. Possible conflicts
j. Compatibility problems
k. Time schedules
l. Weather limitations
m. Manufacturer's written recommendations
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. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes within three (3) days of meeting date.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Project Closeout Conference: Schedule and conduct Project closeout conference, at a time convenient to Owner and Design Professional, but no later than [number] 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, Design Professional, 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: Distribute the agenda to all invited attendees in advance of meeting. 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 preparing sustainable design documentation
   e. Requirements for preparing operations and maintenance data
   f. Requirements for demonstration and training
   g. Preparation of Contractor's punch list
   h. Procedures for processing Applications for Payment at Substantial Completion and for final payment
   i. Submittal procedures
   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 within three (3) days of meeting date.

E. Progress Meetings: Conduct progress meetings at agreed upon intervals.
1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner, Owner's Commissioning authority, Construction Manager, and Design Professional, each contractor, 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: Distribute the agenda to all invited attendees in advance of meeting. 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.
      Review schedule for next period.
   b. Review present and future needs of each entity present, including the following:
      Interface requirements
      Sequence of operations
      Status of submittals
      Deliveries
      Off-site fabrication
      Access
      Site utilization
      Temporary facilities and controls
      Progress cleaning
      Quality and work standards
      Status of correction of deficient items
      Field observations
      Status of RFIs
      Status of proposal requests
      Pending changes
      Status of Change Orders
      Pending claims and disputes
      Documentation of information for payment requests
      Recommendations of construction feasibility
      Safety precautions and programs

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information within three (3) days of meeting date.
   a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

F. Coordination Meetings: Conduct project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and pre-installation conferences.
   1. Attendees: In addition to representatives of Owner and Design Professional, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
   2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
      a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
      b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
      c. Review present and future needs of each contractor present, including the following:
         Interface requirements
         Sequence of operations
         Status of submittals
         Deliveries
         Off-site fabrication
         Access
         Site utilization
         Temporary facilities and controls
         Work hours
         Hazards and risks
         Progress cleaning
         Quality and work standards
         Change Orders
   3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting, within three (3) days of meeting date.
   4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes within three (3) days of meeting date.

G. Meetings Requested by Owner: While not necessarily coinciding with dates of other meetings, Owner reserves the right to call and conduct meetings with project participants as the need arises.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

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. Pre-construction photographs
   2. Periodic construction photographs
   3. Final completion construction photographs
   4. Owner may elect to retain an independent firm to photographically document the progress of the work. Work of this firm shall not diminish or replace responsibilities of the Contractor for documentation required by this section. Contractor to cooperate fully with independent photographer.

1.3 UNIT PRICES

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

1.4 INFORMATIONAL SUBMITTALS

A. Digital Photographs: Submit image files within three days of taking photographs.
   1. Digital Camera: Minimum sensor resolution of 8 megapixels.
   2. Format: Minimum 1600 by 1200 pixels, 400 dpi minimum, in unaltered original files, with same aspect ratio as the sensor, un-cropped, 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 of Design Professional
      c. Name of Contractor
      d. Date photograph was taken
      e. Description of location, direction (by compass point), and elevation or story of construction

1.5 COORDINATION

A. Auxiliary Services: Cooperate with photographer and provide auxiliary services requested, including access to Project site and use of temporary facilities.

1.6 USAGE RIGHTS

A. Obtain and transfer copyright usage rights from photographer to Owner for unlimited reproduction of photographic documentation.

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 1600 by 1200 pixels and 400 dpi.

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. Pre-construction Photographs: Before commencement of excavation, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
   1. Flag construction limits before taking construction photographs
   2. Take twenty (20) photographs to show existing conditions adjacent to property before starting the Work
   3. Take twenty (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 twenty (20) photographs monthly (unless otherwise directed), 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 as indicated, to show status of construction and progress since last photographs were taken.
   1. Frequency: Take photographs weekly, with timing each month adjusted to coincide with the cutoff date associated with each Application for Payment.
   2. Vantage Points: Following suggestions by Architect and Contractor, photographer to select vantage points. During each of the following construction phases, take not less than two of the required shots from same vantage point each time to create a time-lapse sequence as follows:
      a. Commencement of the Work, through completion of subgrade construction
      b. Above-grade structural framing
      c. Exterior building enclosure
      d. Interior Work, through date of Substantial Completion

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 Design Professional'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 Design Professional'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. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or modifications to submittals noted by the Design Professional 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 start-up construction schedule. Include submittals required during the first sixty (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.

   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 Design Professional's final release or approval
   g. Scheduled dates for purchasing
   h. Scheduled dates for installation
   i. Activity or event number

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Design Professional's Digital Data Files: Design Professional will provide electronic copies of CAD Drawings for Contractor's use in preparing coordination submittals.

1. Design Professional will furnish Contractor one (1) set of drawing files for use in preparing Shop Drawings and Project record drawings.

2. Design Professional makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
3. Digital Drawing Software Program: The Contract Drawings are available in [Type] software.
4. Contractor shall execute a data licensing agreement in the form of Agreement included in Project Manual.
5. CAD files will by furnished for each appropriate discipline.

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 approved by Design Professional.
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.
5. Design Professional reserves 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 Design Professional's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals. Submittals received after 1:00 pm will be considered to have been received the following day.
1. Allow ten (10) business days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Design Professional will advise Contractor when a submittal being processed must be delayed for coordination. Allow fifteen (15) business days for review time for large or complex submittals will require additional review time. The following are examples but not limited to such submittals, Millwork, Curtain Wall, Structural Steel, Doors, Frames, Hardware (total opening).
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow ten (10) business days for review of each resubmittal.
4. Sequential Review: Where sequential review of submittals by Design Professional's consultants, Owner, or other parties is indicated, allow fifteen (15) business days for initial review of each submittal.

D. Identification and Information: Place a permanent label or title block on each copy submittal item for identification.
1. On large format Shop Drawings, Contractor shall stamp each individual page as well as the reviewer’s stamp.
2. Indicate name of firm or entity that prepared each submittal on label or title block.
3. Provide a space approximately 6-inches by 8-inches on label or beside title block to record Contractor's review and approval markings and action taken by Design Professional.
4. Include the following information for processing and recording action taken:
    a. Project name
    b. Date
    c. Name of Design Professional
    d. Name of Contractor
    e. Name of subcontractor
    f. Name of supplier
    g. Name of manufacturer
    h. Submittal number or other unique identifier, including revision identifier
        1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
    i. Number and title of appropriate Specification Section
    j. Drawing number and detail references, as appropriate
    k. Location(s) where product is to be installed, as appropriate
    l. Other necessary identification

E. Identification and Information: Identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a single indexed file with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.

a. For typical projects that do not require separate submittals for different buildings or sub the submittal file name shall use Specification Section number followed by a dash and then a sequential number. Resubmittals shall include an numerical suffix after another dash. Include brief description of submittal after sequential number or resubmittal suffix. (e.g., 061000-001-0 Rough Carpentry).
b. For complex projects that require project identifier for separate buildings within a project or require individual submittals to be submitted by multiple subcontractors, the submittal file name shall follow the following: Specification Section number followed by a decimal point and then a sequential number. Resubmittals shall include an alphabetic suffix after another decimal point. Project Identifier should follow in parentheses (e.g., 061000-001-0 (LNHS) Rough Carpentry).

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Design Professional.
4. Include the following information on an inserted cover sheet:
   a. Project name
   b. Date
   c. Name and address of Design Professional
   d. Name of Contractor
   e. Name of firm or entity that prepared submittal
   f. Name of subcontractor
   g. Name of supplier
   h. Name of manufacturer
   i. Number and title of appropriate Specification Section
   j. Drawing number and detail references, as appropriate
   k. Location(s) where product is to be installed, as appropriate
   l. Related physical samples submitted directly
   m. Other necessary identification
5. Include the following information as keywords in the electronic file metadata:
   a. Project name
   b. Number and title of appropriate Specification Section
   c. Manufacturer name
   d. Product name

F. Options: Identify options requiring selection by the Design Professional.
G. Deviations: Identify deviations from the Contract Documents on submittals.
H. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Design Professional observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
   1. Submit one (1) copy of submittal to concurrent reviewer in addition to specified number of copies to Design Professional.
I. Transmittal: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Design Professional will return submittals, without review, received from sources other than Contractor.
   1. Transmittal Form: Use standard contractor form as approved by Design Professional Owner.
   2. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Design Professional on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
J. 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. Include all submitted information from previous submittal in resubmittal, to form a comprehensive document for Design Professional’s review.
   4. Resubmit submittals until they are marked with ‘Reviewed’, ‘Furnish as Corrected’ notation from Design Professional's action stamp, or with approval notation from alternate reviewer
K. 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.
L. Use for Construction: Use only final submittals that are marked with ‘Reviewed’, ‘Furnish as Corrected’ notation from Design Professional's action stamp, or with approval notation from alternate reviewer.

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. Email or upload electronic submittals as PDF electronic files directly to Design Professional's Info Exchange Folder specifically established for Project.
      a. Design Professional will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
   2. Action Submittals: For large format drawings and submittals (larger than 11x17), submit PDF file plus two (2) hard copies. For smaller format drawings and submittals (11x17 or less), provide only PDF file. Design Professional will return only the marked-up PDF.
   3. Informational Submittals: Submit two paper copies of each submittal, unless otherwise indicated. Design Professional will not return copies.
   4. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section 017700, "Closeout Procedures".
   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.
   6. Test and Inspection Reports Submittals: Comply with requirements specified in Division 01 Section 014000, "Quality Requirements".

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. Standard color charts
      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.
   1. Submittals containing reproduction of Contract Drawings are not considered Shop Drawings and will be returned without action. Any delay due to such rejection will not be grounds for an extension of Contract Time.
   2. 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
   3. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
   4. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8 ½ -inches by 11-inches but no larger than 30-inches by 42-inches.

5. Submit Shop Drawings in the following format:
    a. For large format drawings and submittals (larger than 11 x 17), submit PDF file plus two (2) hard copies. For smaller format drawings and submittals (11x17 or less), provide only PDF file. Design Professional will return only the marked-up PDF.

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
3. 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.
4. 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 three (3) full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Design Professional will return submittal with options selected.
5. 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. Design Professional will retain one sample set; 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.
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. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section 013200, "Construction Progress Documentation".

G. Application for Payment: Comply with requirements specified in Division 01 Section 012900, "Payment Procedures".

H. Schedule of Values: Comply with requirements specified in Division 01 Section 012900, "Payment Procedures".

I. 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. Use CSI Form 1.5A. 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.

4. Submit subcontract list in the following format:
    a. PDF electronic file

J. Coordination Drawings: Comply with requirements specified in Division 01 Section 013100, "Project Management and Coordination".

K. 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 Design Professionals and owners, and other information specified.

L. 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 American Welding Society (AWS) forms. Include names of firms and personnel certified.

M. 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.

N. 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.

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

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

Q. 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.

R. Product Test Reports: Submit written reports indicating 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.

S. 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

T. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section 014000, "Quality Requirements".

U. Pre-construction 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 reports indicating and interpreting results of field tests either performed during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

X. Maintenance Data: Comply with requirements specified in Division 01 Section 017823, "Operation and Maintenance Data".

Y. 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, 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 Design Professional.

B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file and three (3) 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 Design Professional.

B. Project Closeout and Maintenance/Material Submittals: Refer to requirements in Division 01 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 DESIGN PROFESSIONAL'S ACTION

A. General: Design Professional will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: Design Professional will review each submittal, make marks to indicate corrections or modifications required, and return it. Design Professional will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:
   1. Reviewed
   2. Revise and Resubmit
   3. Rejected
   4. Furnish As Corrected
   5. No Action Taken

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

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

E. Incomplete submittals are not acceptable, will be considered non-responsive, and will be returned without review.

F. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION

Advancement of Constructio Technology

SUBCONTRACTORS AND MAJOR MATERIAL SUPPLIERS LIST

Project: _____

From (Contractor): _____

Date: _____

To (A/E): _____

A/E Project Number: _____

Contract For: _____

List Subcontractors and Major Material Suppliers proposed for use on this Project as required by the Construction Documents. Attach supplemental sheets if necessary.

Section Number	Section Title	Firm	Address	Phone Number (Fax Number)	Contact

☐ Attachments

Signed by: Date:

Copies: ☐ Owner ☐ Consultants ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ File

SECTION 013516

ALTERATION PROJECT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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. Products and installation for patching and extending Work within construction areas of existing facilities.
   2. Providing transition and adjustments
   3. Repair of damaged surfaces and finishes

B. Related Sections include the following:
   1. Division 01 Section 015000 “Temporary Facilities and Controls” for construction of temporary fire-rated partitions to separate existing occupied areas from construction areas.

1.3 OCCUPANCY, ACCESS, AND PROTECTION

A. Entire existing facility or any portion thereof will be occupied during progress of construction for conduct of normal operations. Phase Work in accordance with Section 011000, “Summary”.

B. Cooperate with Owner in scheduling operations to minimize conflict and to permit continuous usage. Perform work not to interfere with operations of occupied areas.

C. Existing facilities will remain in full operation during execution of this Work. Exercise every precaution to ensure safety and protection for existing facilities, occupants, merchandise, pedestrians, and vehicles. The following must meet required codes and accessibility requirements.
   1. Maintain safe access and egress at all times for occupants, pedestrians, and vehicles.
   2. Provide protection to prevent damage to facilities, merchandise, and vehicles from dust, water, weather, and other similar harmful elements. Refer to Section 015000, “Temporary Facilities and Controls” for additional requirements.
   3. Maintain exiting from facilities to provide safe passage complying with applicable codes.

1.4 SCHEDULING OF WORK

A. Make arrangements with Owner and schedule Work to avoid interference with normal operations of occupied areas. Submit schedule and summary of applicable Work within occupied areas and obtain Owner approval not less than two (2) days prior to commencement of such Work.
   1. Requests for use of certain existing loading docks, passage ways, and other similar spaces within areas outside limits of construction operations will be limited to day-by-day basis and must be approved in advance by Owner.

B. Coordinate access and scheduling of Work within tenant areas with Owner.

1.5 TORCH-CUTTING AND WELDING PROCEDURES

A. Notify Owner in advance of torch-cutting and welding operations performed within occupied areas; obtain approval prior to proceeding with such operations.
   1. Neither open-flame torch-cutting, welding nor arc-welding are allowed without having secured appropriate permit from Fire Marshal or authority having jurisdiction.
   2. Keep portable fire extinguisher of appropriate class within reach during welding or torch-cutting operations.
   3. Screen arc-welding from vision of passersby.

B. Maintain a “Fire Watch” for minimum of sixty (60) minutes after completion of each torch-cutting and welding operation.

1.6 UTILITY SERVICE OUTAGES

A. Keep utility and service outages to minimum and perform only after written approval of Owner is received.
   1. Requests for outages will not be considered unless they include an identification of areas which will be affected by proposed outage.
   2. Schedule outages for times other than normal business hours.
   3. Make requests for outages minimum of five (5) calendar days in advance of proposed outage.

B. Contractor: Responsible for investigating utility and service lines to determine effect of outage upon

building operations outside of limit of operations. Obtain approval in advance from Owner to execute investigations.

1.7 KEYS

A. When necessary to perform Work, Owner will issue keys to existing mechanical/electrical equipment spaces.

B. Return keys at end of warranty period.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Type and Quality of Existing Products: Use products or types of construction that exist in structure, as needed to patch, extend, or match existing Work.

1. Generally, Contract Documents do not define products or standards of workmanship present in existing construction.
2. Determine by inspecting and testing products where necessary, referring to existing work as quality standard.

B. New Materials: Comply with Specifications for each product involved.

1. Match existing products and work for patching existing work.

C. Materials for Temporary Fire-Rated Partitions: Comply with provisions of Division 01 Section 015000 “Temporary Facilities and Controls”.

D. Salvaged Materials: Salvage sufficient quantities of cut or removed material to replace damaged Work of existing construction, when material is not readily obtainable on current market.

1. Store salvaged items in dry, secure place on site.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Comply with provisions of Division 01 Section 017300, “Execution”.

1. Responsible for verifying existing conditions to determine that all areas meet constructability and are ready for alteration and remodeling.

B. Discrepancies: Verify dimensions and elevations indicated in layout of existing work.

1. Prior to commencing work, carefully compare and check Contract Documents for discrepancies in locations or elevations of work to be executed.
2. Refer discrepancies among Drawings and existing conditions to Design Professional for adjustment before work affected is performed.

3.2 PREPARATION

A. Construct temporary fire-rated partitions to separate existing occupied areas from construction and alteration areas. Comply with provisions of Division 01 Section 015000, “Temporary Facilities and Controls”.

B. Cut, move, or remove items as necessary for access to alteration and renovation Work.

1. Remove unsuitable material not marked for salvage, such as rotted wood, corroded metals, deteriorated masonry and concrete, and other deteriorated materials. Replace materials as specified for finished Work.
2. Remove debris and abandoned items from area and from concealed spaces.

C. Cutting and Removal: Perform cutting and removal work to remove minimum necessary, and in manner to avoid damage to adjacent work. Cut finish surfaces such as masonry, tile, plaster, or metals by methods to terminate surfaces in straight line at natural point of division.

D. Prepare surfaces and remove surface finishes as necessary to provide for proper installation of new materials and finishes.

E. Close openings in exterior surfaces to protect existing Work from weather and extremes of temperature and humidity. Insulate ductwork and piping to prevent condensation in exposed areas.

F. Provide temporary barriers and closures to control operations to prevent spread of dust to occupied portions of building; refer to Division 01 Section 015000, “Temporary Facilities and Controls”.

3.3 INSTALLATION

A. Coordinate Work of alterations and renovations to expedite completion and to accommodate Owner occupancy.

B. Remove, cut, and patch Work in manner to minimize damage and to provide means of restoring products and finishes to specified condition.

1. Refinish visible existing surfaces to remain in renovated rooms and spaces, to specified condition for each material, with neat transition to adjacent finishes.

C. Install products as specified in individual Specification sections.
D. Where new Work abuts or aligns with existing, perform smooth and even transition to match existing adjacent surface in texture and appearance.
   1. When finished surfaces are cut so that smooth transition with new Work is not possible, terminate existing surface along straight line at natural line of division and request instructions from Design Professional as to method of making transition.

3.4 ADJUSTMENTS
A. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to provide smooth plane without breaks, steps, or soffits.
B. Trim existing doors as necessary to clear new floor finish. Refinish trim as required.
C. Fit Work at penetrations of surfaces as specified in Division 01 Section 017300, “Execution”.
D. Patch or replace portions of existing surfaces which are damaged, lifted, discolored, or showing other imperfections. Repair substrate prior to application of finishes.

3.5 FINISHES
A. Finish new surfaces as specified in individual Specification sections.
B. Finish patches to produce uniform finish and texture over entire area. When finish cannot be matched, refinish entire surface to nearest intersections.

3.6 CLEANING
A. Comply with Division 01 Section 017700, “Closeout Procedures”. Thoroughly clean areas and spaces affected by Work. Completely remove paint, mortar, oils, putty and items of similar nature.
B. Clean Owner occupied areas daily. Clean spillage, overspray, and heavy collection of dust in Owner occupied areas immediately.

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 Design Professional, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Sections:

1. Divisions 02 through 49 Sections for specific test and inspection requirements.

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 Design Professional.

C. Mockups: Full size physical assemblies that are constructed onsite. 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. Laboratory Mockups: Full-size, physical assemblies constructed at testing facility to verify performance characteristics.
2. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on the project site, consisting of multiple products, assemblies and subassemblies.
3. 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. Pre-construction Testing: Tests and inspections performed specifically for the 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, i.e., plant, mill, factory, or shop.

G. Field Quality Control Testing: Tests and inspections that are performed onsite 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 or trades.

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 Design Professional and Owner 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 Design Professional 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 (2) dimensions.

1.6 INFORMATIONAL SUBMITTALS

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

B. Contractor's Quality Control Manager Qualifications: For supervisory personnel.

C. 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.

D. 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 timespan 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 ten (10) days of Notice to Proceed, and not less than five (5) days prior to pre-construction conference. Submit in format acceptable to Design Professional. 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: Include in quality control plan 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’s 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, if applicable.

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 Design Professional 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 re-inspecting

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

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.
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. Pre-construction Testing: Where testing agency is indicated to perform pre-construction 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. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
    f. When testing is complete, remove test specimens, assemblies, 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 Design Professional, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in location and of size indicated or, if not indicated, as directed by Design Professional.
2. Notify Design Professional five (5) business days in advance of dates and times when mockups will be constructed.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at the Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Obtain Design Professional's approval of mockups before starting work, fabrication, or construction.
    a. Allow seven (7) days for initial review and each re-review of each mockup.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed, unless otherwise indicated.

L. Integrated Exterior Mockups: Construct integrated exterior mockup in accordance with approved Shop Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual specification sections, along with supporting materials.

M. [Room Mockups: Construct room mockups incorporating required materials and assemblies, finished in accordance with requirements. Provide required lighting and additional lighting where required to enable Design Professional to evaluate quality of the Work. Provide room mockups of the following rooms:
_____].

N. [Laboratory Mockups: Comply with requirements of pre-construction testing and those specified in individual Specification Sections in Divisions 02 through 49.]

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 re-inspecting 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 Division 01 Section 013000, "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 pre-installation 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. Re-testing/Re-inspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality control services, including retesting and re-inspecting, for construction that replaced Work that failed to comply with the Contract Documents.

F. Testing Agency Responsibilities: Cooperate with Design Professional and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
   1. Notify Design Professional 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. Does 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.

1.11 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Conducted by a qualified testing agency 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 reviewing the completeness and adequacy of those procedures to perform the Work.
   2. Notifying Owner, Design Professional 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 Design Professional with copy to Contractor and to authorities having jurisdiction.
   4. Submitting a final report of special tests and inspections at Substantial Completion, this 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 re-inspecting corrected work

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. 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 Design Professional
   4. Identification of testing agency or special inspector conducting test or inspection

B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Design Professional'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 Division 01 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

UNT SYSTEM REGULATORY REQUIREMENTS

SECTION 014100

PART 1 GENERAL

1.1 SUMMARY

A. Design and construction codes applicable to UNT System projects are as follows:

1. National Fire Protection Association (NFPA)
   a. 2018 edition NFPA 1 Fire Code
   b. 2013 edition NFPA 13 Standard for the installation of [Fire] Sprinkler Systems
   c. 2013 edition NFPA 13R Standard for the installation of [Fire] Sprinklers in Low-Rise Residential Buildings
   d. 2013 edition NFPA 14 Standards for the Installation of Standpipe and Hose Systems
   e. 2013 edition NFPA 20 Standard for the Installation of Stationary Pumps for Fire Protection
   f. 2013 edition NFPA 24 Standard for the Installation of Private Fire Service Mains and Their Appurtenances
   g. 2017 edition NFPA 70 National Electric Code
   h. 2013 edition NFPA 72 National Fire Alarm Signaling Code
   i. 2018 edition NFPA 101 Life Safety Code
2. International Building Code Conference (ICC)
   a. 2018 edition International Building Code,
   b. 2018 edition International Mechanical Code,
   c. 2018 edition International Plumbing Code,
   d. 2018 edition International Fire Code,
      1) Including Municipal fire code amendments of the city[1] where the building is being constructed, pertaining only to the following, shall be used in the project design and construction:
         i) water supply for fire suppression;
         ii) fire hydrant number and locations;
         iii) fire department access to the building;
         iv) KNOX® key access boxes – contact UNT System Fire Marshal for specifics;
         v) fire department connections (FDC & its location);
         vi) fire sprinkler and standpipe systems;
         vii) fire detection & alarm systems;
         viii) elevator stretcher requirements*****;
         ix) communication coverage;
         x) other emergency equipment requirements.
   e. 2018 edition International Fuel Gas Code
   f. 2018 edition International Energy Conservation Code
3. *Design & Construction Guidelines – The University of North Texas*
   a. (access the UNT Facilities Resources webpage at http://facilities.unt.edu/resources. "Under Projects & Renovations", click on the "Design Guidelines – UNT" hyperlink)
   b. For design guidelines specific to UNT Discovery Park – access the UNT facilities Resources webpage at http://facilities.unt.edu/resources. "Under Projects & Renovations", click on the "Design Guidelines – RP Appendix" hyperlink.
   c. Questions regarding the *Design & Construction Guidelines – The University of North Texas* are to be emailed to: Peter.Palacios@unt.edu
4. Elevator and Escalator Construction
   a. *Elevators, Escalators and Related Equipment, Administrative Rules of the Texas Department of Licensing and Regulation, 16 Texas Administrative Code, Chapter 74, §74.100 (Effective February 15, 2016).*
   b. *****2018 edition International Building Code (IBC), Chapter 30.
5. Accessibility Standards
   2012 Texas Accessibility Standards (2012 TAS). (Elimination of Architectural Barriers Texas Government Code, Chapter 469. Administered by the Texas Department of Licensing and Regulation. Effective March 15, 2012).

[1] Respectively: City of Denton, TX; City of Ft. Worth, TX.; City of Dallas, TX; City of Frisco, TX

6. Energy Conservation Design Standards for New Construction and Major Renovation[2] Projects:
   a. 2015 edition International Energy Conservation Code (IECC);
   b. Low-Rise Residential Buildings[3] -- use Residential Section of 2015 edition IECC.
7. Water Conservation Standards
   "Water Conservation Design Standards for State Buildings and Institutions of Higher Education Facilities" prepared by SECO, dated April 2016, as the water conservation design standards for any new construction or major renovation project. Download available at: https://comptroller.texas.gov/programs/seco/code/

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

[2] Major Renovation Projects: *For the purposes of this subchapter, a major renovation project is a building renovation or improvement where the implementation cost associated with energy or water efficiency improvements is $2 million or more, based on the initial engineering cost estimate. 34 Tex. Admin. Code §19.33.*
Source Note*: The provisions of this §19.33 adopted to be effective August 13, 2002, 27 TexReg 7174; amended to be effective September 28, 2011, 36 TexReg 6303; amended to be effective April 7, 2016, 41 TexReg 2495.*

[3] Low-Rise Residential Building: Residential buildings not more than three stories in height above grade that includes sleeping accommodations and a separate means of egress, and where the occupants are primarily permanent in nature (30 or more days in occupancy).

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 Design Professional's action on Contractor's submittals, applications, and requests, "approved" is limited to Design Professional's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Design Professional. 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": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

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.

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

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

1.4 ABBREVIATIONS AND ACRONYMS

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

B. Following are acronyms used by Owner in the Contract Documents:

1. A/E: Architect/Engineer
2. AHJ: Authority Having Jurisdiction
3. BOR: Board of Regents
4. CCD: Construction Change Directive
5. CCL: Construction Cost Limitation
6. CMAR: Construction Manager at Risk
7. CSP: Competitive Sealed Proposal
8. DD: Design Development
9. FPE: Fire Protection Engineer
10. GCs: General Conditions
11. GMP: Guaranteed Maximum Price
12. GSF: Gross Square Feet
13. HSP: HUB Subcontractor Plan

14.	HUB:	Historically Underutilized Business
15.	LA:	Landscape Architect
16.	LEED:	Leadership in Energy and Environmental Design
17.	LDs:	Liquidated Damages
18.	NASF:	Net Assignable Square Feet
19.	NTP:	Notice to Proceed
20.	OAC:	Owner/Architect/Contractor
21.	OCM:	Owner's Construction Manager
22.	ODR:	Owner's Designated Representative
23.	PAR:	Progress Assessment Report
24.	PE:	Professional Engineer
25.	PM:	Project Manager
26.	RID:	Registered Interior Designer
27.	R&R:	Repair and Rehabilitation
28.	SD:	Schematic Design
29.	SDs:	Schematic Design Drawings
30.	UGC/SGC:	Uniform General Conditions/Supplemental General Conditions

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 own forces, Design Professional, testing agencies, and authorities having jurisdiction.

B. Sewer Service: Owner will pay sewer service use charges for sewer usage by all entities for construction operations.

C. Water Service: Owner will pay water service use charges for water used by all entities for construction operations.

D. Electric Power Service: Owner will pay electric power service use charges for electricity used by all entities for construction operations.

E. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

F. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required 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. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage, including delivery, handling, and storage provisions for materials subject to water absorption or water damage, discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water damaged Work.

1. 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.

D. Dust-Control and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust-control 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 the work
2. HVAC system isolation schematic drawing
3. Location of proposed air filtration system discharge
4. Other dust-control measures
5. Waste management plan
6. Comply with other requirements on a per Campus basis

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-inchthick, galvanized steel, chain-link fabric fencing; minimum 6-feet high with galvanized steel pipe posts; minimum 2⅜ -inch OD line posts and 2⅞-inch OD corner and pull posts, with 1⅝-inch OD top rails.

B. Portable 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 2⅜-inch OD line posts and 2⅞-inch OD corner and pull posts, with 1⅝-inch OD top and bottom rails. Provide galvanized steel bases for supporting posts.

C. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mils minimum thickness, with flame-spread rating of 15 or less per ASTM E 84.

D. Dust Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches.

E. 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, Design Professional, Construction Manager, 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 not less than 1 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.

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 testing agency acceptable to authorities having jurisdiction, and marked for intended use.
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 Division 01 Section 017700 "Closeout Procedures".

C. Air Filtration Units: HEPA primary and secondary 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.
   1. Locate facilities to limit site disturbance as specified in Division 01 Section 011000, "Summary."

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

3.2 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. [Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.]

E. 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.

F. 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.

G. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
   1. Prior to commencing work, isolate the HVAC system in area where work is to be performed in accordance with approved coordination drawings.
      a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
      b. Maintain negative air pressure within work area using HEPA-equipped air filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
   2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust containment devices.
   3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

H. 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.

I. [Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.]

J. [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.]

K. 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.

L. Telephone:
1. Post a list of important telephone numbers.
a. Police and fire departments
b. Ambulance service
c. Contractor's home office
d. Architect's office
e. Engineers' offices
f. Owner's office
g. Principal subcontractors' field and home offices
2. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

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 Design Professional 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 sub-base and base for temporary roads and paved areas according to Division 31 Section [Insert Section number], "Earth Moving".
3. Recondition base after temporary use, including removing contaminated material, re-grading, proof rolling, 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: Use designated areas of Owner's existing 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 nor 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 Division 01 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.
I. Temporary Elevator Use: Refer to Division 14 Sections for temporary use of new elevators.
J. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
K. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION
A. 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 Division 01 Section 011000, "Summary."
B. Temporary Erosion and Sedimentation Control: Comply with requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent and requirements specified in Division 31 Section [Insert Section number], "Site Clearing."

C. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
D. Tree and Plant Protection: Comply with requirements specified in Division 01 Section 015639, "Temporary Tree and Plant Protection."
E. 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. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials.
F. 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.
G. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.
H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
I. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
J. 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 weather-tight enclosure for building exterior.
    1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.
K. 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 plywood on construction operations side.
    2. Construct dustproof partitions with two layers of 6-mil polyethylene sheet on each side. Cover floor with two layers of 6-mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant treated plywood.
        a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48-inches between doors. Maintain water-dampened foot mats in vestibule.
    3. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
    4. Insulate partitions to control noise transmission to occupied areas.
    5. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
    6. Protect air-handling equipment.
    7. Provide walk-off mats at each entrance through temporary partition.
L. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
    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 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 forty-eight (48) hours are considered defective.
b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record daily readings over a forty-eight (48) hour period. Identify materials containing moisture levels higher than allowed. Report findings in writing to Design Professional.
c. Remove materials that can not be completely restored to their manufactured moisture level within forty-eight (48) hours.

E. Refer to Section 015300, Mold Prevention Measures, for additional requirements.

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 twenty-four (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 Division 01 Section 017700, "Closeout Procedures."

END OF SECTION

SECTION 015300

MOLD PREVENTION MEASURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes: Administrative and procedural requirements to help prevent mold contamination in construction. This section is in addition to requirements contained in Division 01 Section 015000, “Temporary Facilities and Controls”.

1.3 SUBMITTALS

A. Reports: Submit reports required in this Section, including but not limited to the following:
   1. Sightings of existing mold
   2. Window and storefront testing
   3. Moisture contents of materials
   4. Exterior sealant cracks, damage, and deterioration

1.4 QUALITY ASSURANCE

A. Pre-construction Meeting: Review requirements of this Section at Pre-construction Meeting.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

B. Do not bring finish materials into building until building is in a conditioned state. Protect finish materials stored within building. Stage materials off the floor and cover with waterproof covering. Examples of these materials include, but are not limited to, insulation, gypsum products, wall coverings, carpet, ceiling tile, wood products, etc.

C. Remove from Project site damaged materials or materials that have become wet. Do not install such materials.

1.6 PROJECT CONDITIONS

A. Perform daily visual inspections of existing building for existing mold. Report sightings of mold to Architect.

B. Remove water found within building during construction immediately.
   1. Energize lift stations and sump pumps as early in Project as possible. Use temporary pumps if necessary to get water out of building and drain lines.

C. Ventilation:
   1. Verify that existing HVAC system is providing positive pressure in building.
   2. Provide adequate air circulation and ventilation during demolition phase(s).
   3. Seal off return air ducts and diffusers to prevent construction dust and moisture from entering occupied areas and HVAC system.
   4. Provide temporary outside air ventilation as building becomes enclosed.

D. Maintain clean project site, free from hazards, garbage, and debris.

E. Eating, drinking, and smoking are not permitted within building.

F. Slope perimeter grades, both temporary and final grades, away from building structure.

G. Verify that condensate pans drain properly beginning with initial installation.

H. Flash roof penetrations immediately. Do not allow water to penetrate to floor below.

I. Seal window openings prior to window installation with plastic to prevent moisture entry.

J. Sprayed-on Fireproofing: Keep air moving throughout building when using sprayed-on fireproofing.

K. Cover stored and installed ductwork and installed duct openings with plastic to prevent dust, debris, and moisture from entering ductwork. Repair damaged plastic barrier.

L. Do not operate air handling equipment below 60° F supply air temperature until building is 100 percent enclosed.

M. Monitor humidity and temperature for conformance to installation requirements defined by material and equipment manufacturers.

N. Check moisture content of gypsum board prior to applying finishes. Record findings.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 INSTALLATION

A. Roof Drains: Connect roof drains to risers and storm drainage lines as soon as possible.

B. Floor Drains: Connect floor drains as soon as possible. Cover floor drains with tape during construction to keep construction debris from blocking drain. Clean out floor drain lines to mains prior to Substantial Completion.

C. Wall Assemblies:
   1. Install exterior wall insulation, vapor retarder, and gypsum board only after building is enclosed.
   2. Keep bottom of installed gypsum board off floor ½ -inch.

D. Cavity Conditions: Clean and inspect cavity conditions prior to covering, sealing, or restricting access. Vacuum-clean cavity spaces prior to covering or enclosing.

E. Sprayed-On Fireproofing: Remove sprayed-on fireproofing overspray immediately.

F. Plumbing: Pressure test plumbing piping identified as insulated on Project prior to installation of insulation.

G. Roof Mounted Equipment: Inspect rooftop units and other roof-mounted equipment for signs of rain leaks immediately after first rain. Water test with hose immediately after installation. Seal leaks immediately.

H. Windows and Storefront: Water test windows to manufacturer's and Project Manual's specifications. Record findings and forward to Architect.

I. Sealants: Inspect exterior sealants for cracks, damage, or deterioration. Record findings and forward to Architect.

J. HVAC Equipment (Permanent HVAC Equipment Used for Temporary Conditioning of Building During Construction Phases): Change filters and clean ductwork interior to remove dirt, dust, debris, and moisture buildup prior to turning Project over to Owner.

3.2 ADJUSTING

A. Remove damaged materials or materials that have become wet. Replace with new materials.

3.3 DEMONSTRATION

A. Train and educate Owner's maintenance personnel on use of building systems. Explain how improper operation and shutting down systems during off periods can create mold problems.

B. Schedule with Owner a review of building for mold problems at 1-year warranty walk-through. Inspect exterior sealants and masonry joints for cracks and other damage or deterioration where water can penetrate building envelope.

C. Explain to Owner the need for Owner to establish annual building review for mold.

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 at 6-inchesabove 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 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.
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
D. Qualification Data: For qualified arborist and tree service firm.
E. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.
F. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes pre-construction 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.

1.5 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. Pre-installation Conference: Will conduct conference at Pre-Construction Meeting.
    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

1.6 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, or gray 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 non-soil materials.
   1. Obtain topsoil only from well-drained sites where topsoil is 4-inches deep 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 the following:
   1. Type: Shredded hardwood, fully composted.
   2. Size Range: 3-inches maximum, ½ -inch minimum
   3. Color: Natural

C. Protection Zone Fencing: Fencing fixed in position and meeting the following requirements (previously used materials may be used when approved by Architect):
   1. Protection Zone Fencing: 4’ tall, heavy duty HDPE, high visibility orange, safety fencing. with rigid metal t-posts, minimum 6’ tall installed 2’ into the ground

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 3-inch average thickness of organic mulch. Do not place mulch within 6-inches of tree trunks.

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 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. Locate buried utilities and irrigation around trees and adjust tree protection fencing to miss utilities and maintain irrigation system as required before setting tree protection fencing.
2. Safety Fencing: Install and maintain throughout the duration of construction.
3. 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.
4. Access Gates: Install as necessary; 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. Maintain protection zones free of weeds and trash.

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

D. 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 pre-approval 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 Division 31 "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, air spade, 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. Where construction is required within the tree protection zone, provide 2”X4” wood barrier around the trunk of the tree. Replace barrier fencing as soon as possible after work in the tree protection zone is complete.

D. Redirect roots in backfill areas where possible. If encountering large roots, 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.

E. 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.

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: Coat cut ends of roots more than 1-inch in diameter with an approved root sealant.
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.
6. 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

B. 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.

1. Prune trees to remain to compensate for root loss caused by damaging or cutting root system at the direction of the Owner and Architect. 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. Apply pruning paint to wounds.

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 un-compacted 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.
   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.
   2. Provide one (1) new tree(s) of 6-inch caliper size for each tree being replaced that measure more than 6-inches in caliper size.
      a. Species: Species selected by Architect.
   3. Plant and maintain new trees as specified in Division 32 “Landscape Planting”.

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. Use Air Spade Technology, 12-inches deep for aeration.

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 and straw bales
   2. Sediment barriers and check dams
   3. Stabilized construction entrance
   4. Construction of temporary swales and sedimentation basins as required
   5. Seeding, sodding, and hydro mulching

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 shall 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.

2.2 STRAW BALES

A. Standard rectangular straw bales bound by baling wire (NO TWINE).

2.3 SEDIMENT TRAPS

A. Standard manufacture designed to fit the intended inlet.

2.4 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.

2.5 GRASS

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

2.6 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.

2.7 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 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 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 straw 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 brush, stumps, obstructions, and other objectionable material and dispose 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 hydro mulch 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. Remove sediment and other debris trapped by the barriers daily.
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-hydro mulching, bank repair, and debris removal.
F. Sediment removed from the ditches may be re-spread 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 hydro mulching, 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 (⅓) 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 fourteen (14) days if the phasing of the construction operations is anticipated to leave those portions of the areas unworked for twenty-one (21) days or more.
B. Maintain seeded areas until the Owner accepts the project. Maintain by watering, fertilizing, reseeding, mowing and erosion repair as may be required. Cut grass when the average height of the grass reaches 4-inches. Clippings may be mulched back into the seeded areas.

END OF SECTION

SECTION 015720

INDOOR AIR QUALITY PLAN DURING CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY
- A. Section Includes:
  1. Requirements to develop and utilize an indoor air quality plan for the construction operation.
  2. A sample plan applicable to all interior construction and trades.
  3. Reference:
     a. "IAQ Guidelines for Occupied Buildings under Construction", 2008 Edition, by the Sheet Metal and Air Conditioning Contractors National Association, Inc.

1.2 TRAINING
- A. Contractor shall provide copies of the plan and training to all subcontractors and appropriate personnel.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXECUTION
- A. Contractor shall utilize a plan to protect the indoor environments from contamination during construction and finish out similar to the following plan.
- B. Contractor shall enforce and verify compliance by all personnel and subcontractors.
- C. Contractor shall take pictures of the related construction operations to verify conformance to each section of the plan. These pictures will be provided to the Architect. A minimum of eighteen (18) pictures (six (6) pictures taken on three (3) separate occasions) will be submitted.

3.2 INDOOR AIR QUALITY PLAN DURING CONSTRUCTION OPERATIONS
- A. Introduction
  1. This plan outlines the processes required to assure acceptable air quality. Elements of the program include:
     a. HVAC Protection and Containing the work area
     b. Source Control and Modifying HVAC Operation and Reducing Emissions
     c. Pathway Interruptions
     d. Intensifying Housekeeping
     e. Scheduling or Relocation of Occupants

3.3 THESE REQUIREMENTS APPLY TO ALL PARTIES INVOLVED IN DESIGN, CONSTRUCTION, AND BUILDING MOVE IN:
- A. CONTAMINANTS
  1. Air contaminants include many different materials. These may include: gases, vapors, chemicals, mold/fungus, pathogens, allergens, particulates and radiation. Eliminating all of these is not possible but reducing the introduction and distribution of these contaminants is possible and desirable. The programs outlined in the following pages are intended to reduce contaminants and provide as clean a building as possible for the residents.
  2. The following sections outline procedures and precautions to reduce building contamination and meet the requirements for a healthy environment.
- B. CONSTRUCTION OPERATIONS
  1. HVAC PROTECTION: The air conditioning system is the distribution method for air and potential contaminants throughout the building. Keeping the system clean is a necessity.
     a. All air handling equipment, spiral and fabricated ducts and accessories shall be kept clean during transportation, storage and assembly.
     b. All lined, spiral and assembled ducts shall be wrapped and protected from dirt and water during transportation and storage.
     c. All insulation and lined duct shall be kept dry at all times. Any insulation that has become wet shall be removed and replaced.
     d. Fiberglass duct board in the air handlers and bases shall be kept dry and clean. Exposed fiberglass subject to erosion shall be coated with a sealer to prevent the entry of raw fiberglass into the air stream.

1) Water will not be allowed to stand on any mechanical equipment.

e. All open ends of installed duct and equipment shall be covered and sealed to prevent the entry of dirt.
f. All zone boxes shall be wrapped and sealed from dirt and water before installation. Installed zone boxes shall have the openings sealed until permanently connected to the ductwork.
g. All dampers and attenuators into open chases and ducts shall be covered to reduce dirt entry.
h. The air handlers shall not be started without MERV 8 filtration in place. Upon system activation, install sheet media on all return openings and filters in zone box plenum openings. These filters must be monitored and changed as necessary to prevent the entry of dirt into the system. The temporary media shall be removed after building flush out and before occupancy.
i. The return air system should not be used during sheet rock installation, sanding or painting operations.
j. The building should be kept under a positive pressure as much as possible.
k. Chase dampers shall be kept closed until the system is activated.
l. Complete the initial mechanical checklists at system startup.
m. Replace final filters with new filters before flush out or occupancy per design requirements.

2. SOURCE CONTROL
   a. No smoking or tobacco materials shall be allowed on all campuses.
   b. No gasoline or fuel-fired equipment shall be used inside any enclosed building.
   c. Wet processes within the building shall be kept to a minimum.
   d. All chase and wallboard materials shall be protected from water. All damaged materials shall be removed and replaced.
   e. Use low-emission materials and chemicals.
   f. All cleaning involving chemicals shall be performed outside the building wherever possible.
   g. All carpet materials shall be unrolled or unboxed and aired out in a well-ventilated warehouse for a minimum of three days before installation.
   h. All modular furniture shall be aired out in a well-ventilated warehouse for seven days before entry into the building.
   i. Trash shall be cleaned up and removed daily to the appropriate recycle container.
   j. Any mold growth shall be treated according to the procedures shown in the New York City Department of Health “Guidelines on Assessment and Remediation of Fungi in Indoor Environments”.
   k. Clean the inside of all walls at the base track to remove excess materials and dirt with a vacuum cleaner before enclosing the wall. This is particularly critical on walls with plumbing or water piping included.
   l. HEPA vacuum all concrete floors before installation of floor covering materials.
   m. No obvious mold or chemical contamination shall be enclosed, hidden or painted.
3. PATHWAY INTERRUPTION
   a. Dust-producing operations shall be exhausted to the outside to the extent possible.
   b. Exhaust fans may be installed on each floor to remove dust and contaminants.
   c. The air handler shall supply conditioned air to the floors. Floors with heavy dust or chemical operations shall be exhausted to the outside.
   d. During rain or high-humidity conditions, the air supply coming from the coils shall be cooled to 55° F or the air handler stopped to prevent moist air entry into the building. Exhaust fans shall not draw moist air into the building. It is preferable to have little airflow to moist air entering the building.
   e. Return air dampers and openings shall be covered with filter media during operations that may contaminate the system.
   f. During activities producing airborne particulates in occupied buildings undergoing renovation, or projects whose airspace is connected to occupied buildings, dust producing activities such as, but not limited to, demolition, sanding, buffing, and welding, the Contractor will provide commercial high volume air scrubbers at the rate of 1 per 7000 square feet, operate them continuously, and service them per the manufacturer, including high-efficiency particulate arrestance (HEPA) filter replacement.
4. HOUSEKEEPING
   a. Food or food residues shall be properly disposed after meals or breaks.
   b. Once the building is enclosed with finishes applied, keep dirt entry to a minimum with walk off mats at all entrances. Clean the mats at least daily.
   c. All sweeping shall be done with dust reducing wax-based sweeping compounds.
   d. All materials shall be kept clean and stored neatly on dunnage or pallets as required by the manufacturer.

e. Coils, fans, and air handler chambers, including return air chambers, shall be inspected and cleaned if required before start up, final testing and commissioning, and air testing.
f. All workers shall utilize the proper personal protective equipment per OSHA standards during any operation involving chemicals and dust production.
g. No food, drink, or smoking shall be allowed within the building after the building is enclosed.

5. SCHEDULING
   a. Complete all dust producing and chemical operations before the installation of “sink” materials such as carpet and ceiling tile.
   b. Complete the HVAC control system sufficient to allow the operation of the supply and exhaust systems to control pressurization and contaminants.
   c. Group contaminating operations where possible to maximize exhaust use.

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, which 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. Design Professional's Action: If necessary, Design Professional will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Design Professional will notify Contractor of approval or rejection of proposed comparable product request within fifteen (15) days of receipt of request, or seven (7) days of receipt of additional information or documentation, whichever is later.
      a. Form of Approval: As specified in Division 01 Section 013300, "Submittal Procedures".
      b. Use product specified if Design Professional 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 Division 01 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 weather-tight enclosure above ground, with ventilation adequate to prevent condensation.
4. Store 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. Refer to Divisions 02 through 49. Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 01 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", Design Professional 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. Non-restricted 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. Non-restricted 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 Design Professional's sample", provide a product that complies with requirements and matches Design Professional's sample. Design Professional'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 Division 01 Section 012500, "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Design Professional from manufacturer's full range" or similar phrase, select a product that complies with requirements. Design Professional 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: Design Professional will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Design Professional 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, it is consistent with the Contract Documents, 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 Design Professionals and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION

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
   9. Correction of the Work

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. Qualification Data: For land surveyor

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

C. Certified Surveys: Submit two (2) paper copies that are certified, sealed and signed by a Texas registered professional land surveyor. Also submit one copy of the survey in CAD format using surface coordinates and one copy of the survey in CAD format using grid coordinates. Coordinate with Owner for the reference coordinate system and CAD guidelines.

D. Final Property Survey: Submit one (1) digital copy that is certified, sealed and signed by a Texas registered professional land surveyor showing the Work performed. Also submit one copy of the survey in CAD format using surface coordinates and one copy of the survey in CAD format using grid coordinates. Coordinate with Owner for the reference coordinate system and CAD guidelines.

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 Design Professional of locations and details of cutting and await directions from the Design Professional before proceeding. Shore, brace, and support structural element 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 result 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. Conveying systems
      i. Electrical wiring systems

j. 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, which results in reducing their capacity to perform as intended, or that result 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. Equipment supports
   e. Piping, ductwork, vessels, and equipment
   f. 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 Design Professional'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 onsite manufacturer's written recommendations and instructions for installation of products and equipment.

1.6 WARRANTY

A. 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.

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, utilize products for patching that comply with requirements of Division 01 Section 018114, "Sustainable Design Requirements".

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 the Design Professional 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 site work, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work. Surveyor will perform a Locative Survey (Category 3) according to the standards set by the Texas Society of Professional Surveyors Manual of Practice.
   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.
   3. Collect and depict all utility infrastructure according to the Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data published by the American Society of Civil Engineers, publication number CI/ASCE 38-02. All utility data must have a quality level clearly associated, either via a geospatial database, CAD layering, plan symbols, and/or plan labels per the guidelines. Design Professional or Engineer will work with Owner to explain and detail costs and benefits so as to achieve the highest quality levels of subsurface utility engineering applicable to the Project and Work.

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. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
   a. Description of the Work
   b. List of detrimental conditions, including substrates
   c. List of unacceptable installation tolerances
   d. Recommended corrections
2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

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

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of the Contractor, submit a request for information to Design Professional according to requirements in Division 01 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 Design Professional promptly.

B. General: Engage a land 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 dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
   3. Inform installers of lines and levels to which they must comply.
   4. Check the location, level, and plumb of every major element as the Work progresses.
   5. Notify Design Professional when deviations from required lines and levels exceed allowable tolerances.
   6. 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 Design Professional.

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. Do not change or relocate existing benchmarks or control points without prior written approval of Owner and Design Professional. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Design Professional before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish, construct and maintain a minimum of two permanent benchmarks on Project site, referenced to Owner's established geographic coordinate system. Benchmarks will function as both horizontal and vertical benchmarks. A registered professional land surveyor must establish the new benchmarks to meet specifications of National Geodetic Survey (NGS) Class RT1 surveys per the latest version of the User Guidelines for Single Base Real Time GNSS Positioning publication. New and re-set benchmarks will comply with the guidelines specified by Appendix B of the Bench Mark Reset Procedures document published by the NGS agency.
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. Mapping As-built Conditions: Once inspected and approved by Owner, all underground utility locations will be mapped using GPS mapping equipment to decimeter precision or better, prior to backfill, to collect geospatial data on as-built conditions. Any work covered prior to mapping will be required to be uncovered at no cost or schedule impact to the project. Consult with Owner for guidelines on how to collect the geospatial data and what information needs to be recorded about each utility feature. This information will be incorporated into the project record drawings to indicate the horizontal and vertical location of facilities, easements and improvements, as built.

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.

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. Tools and Equipment: Do not use tools or equipment that produces harmful noise levels.

F. 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.

G. 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 Design Professional.
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.

H. 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.

I. 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. Temporary Support: Provide temporary support of work to be cut.
C. 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.
D. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements of Division 01 Section 011000, "Summary".
E. 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 prevent interruption to occupied areas.
F. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
    1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
    2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
    3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
    4. Excavating and Backfilling: Comply with requirements in applicable Division 31 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.
G. 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 re-hang 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 weather-tight condition.
H. 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. Pre-installation Conferences: Include Owner's construction personnel at pre-installation conferences covering portions of the Work that are to receive Owner's work. Attend pre-installation 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.
   1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
   2. Do not hold waste materials more than seven (7) days during normal weather or three (3) days if the temperature is expected to rise above 80° F.
   3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
      a. Utilize containers intended for holding waste materials of type to be stored.
   4. Coordinate progress cleaning for joint-use areas where more than one installer has worked.

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 Division 01 Section 015000, "Temporary Facilities and Controls" and Division 01 Section 017419, “Construction Waste Management and Disposal".

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to 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 Division 01 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 Division 01 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.

3.11 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.
   1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

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 non-hazardous demolition and construction waste
   2. Recycling non-hazardous demolition and construction waste
   3. Disposing of non-hazardous 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 a minimum of seventy-five percent (75%) 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. Concrete
      b. Concrete reinforcing steel
      c. Brick
      d. Concrete masonry units
      e. Doors and frames
      f. Door hardware
      g. Metal studs
      h. Gypsum board
      i. Acoustical tile and panels
      j. Carpet
      k. Carpet pad
      l. Plumbing fixtures
      m. Piping
      n. Mechanical equipment
      o. Refrigerants
      p. Electrical conduit
      q. Copper wiring
      r. Lighting fixtures
      s. Switchgear and panelboards
      t. Transformers
   2. Construction Waste:
      a. Site-clearing waste
      b. Masonry and CMU
      c. Lumber
      d. Wood sheet materials
      e. Wood trim
      f. Metals

g. Carpet and pad
h. Gypsum board
i. Piping
j. Electrical conduit
k. Packaging: Regardless of salvage/recycle goal indicated in paragraph above, salvage or recycle one-hundred percent (100%) 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 thirty (30) days of date established for commencement of the Work.

1.6 INFORMATIONAL SUBMITTALS

A. Waste Reduction Progress Reports: Concurrent with LEED Submittal. 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. 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.
D. 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.
E. LEED Submittal: LEED letter template for Credit MRc5, signed by Contractor, tabulating total waste material, quantities diverted and means by which it is diverted, and statement that requirements for the credit have been met.
F. Qualification Data: For waste management coordinator refrigerant recovery technician.
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. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.
C. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
D. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 01 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 of this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition, site clearing, and construction waste generated by the Work. Use attached form or comparable generated by Contractor. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
   1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
   2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
   3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
   4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
   5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
   6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.

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.

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 Division 01 Section 015000, “Temporary Facilities and Controls" for operation, termination, and removal requirements.

B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.

C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.
   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 Division 01 Section 015000, “Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:
   1. Clean salvaged items.
   2. Pack or crate items after cleaning. Identify contents of containers.
   3. Store items in a secure area until installation.
   4. Protect items from damage during transport and storage.
   5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for Sale and Donation: NOT Permitted on Project site.

C. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

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

E. Plumbing Fixtures: Separate by type and size.

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

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 Contractor.

C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until they are 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 off Owner's property and transport to recycling receiver or processor.

3.4 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: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION

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

1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete with request.
   1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
   2. Advise Owner of pending insurance changeover requirements.
   3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
   4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
   5. Prepare and submit Project Record Documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
   6. Deliver attic stock and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
   7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
   8. Complete startup testing of systems.
   9. Submit test/adjust/balance records.
   10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
   11. Advise Owner of changeover in heat and other utilities.
   12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
   13. Complete final cleaning requirements, including touchup painting.
   14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. 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. Re-inspection: Request re-inspection 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.

1.4 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:
   1. Submit a final Application for Payment according to Division 01 Section 012900, "Payment Procedures".
   2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
   3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
   4. Submit pest-control final inspection report and warranty.

5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection for acceptance. 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. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected. Include cost for re-inspection based on incomplete work of the Contractor.

1.5 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. Use CSI Form 14.1A attached or form provide by Contractor and approved by Owner and Architect.
1. Organize list of spaces in sequential order, starting with exterior areas first.
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. PDF electronic file
   b. ~~Three (3) paper copies of product schedule or list, unless otherwise indicated. Architect will return two (2) copies~~.

1.6 WARRANTIES

A. Submittal Time: Submit written warranties for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

B. Partial Occupancy: Submit properly executed warranties within fifteen (15) days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of the 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 8½ 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. 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 table of contents at beginning of document.~~

D. Provide additional copies of each warranty to include in operation and maintenance manuals. Included digital copies of each warranty within appropriate division of operations and maintenance manuals.

E. After final assembly, scan entire warranty binder into PDF format and deliver to Owner. Deliver entire closeout package to owner in PDF format on a thumb drive.

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 meet Green Seal 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 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 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 clean in unoccupied spaces.
   i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo 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. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
   k. Remove labels that are not permanent.
   l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
      1) Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates.
   m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
   n. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
   o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
   p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
   q. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter upon inspection.
      1) Clean HVAC system in compliance with NADCA Standard ACR-2013.
   r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
   s. Leave Project clean and ready for occupancy.

C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid Project of rodents, insects, and other pests. Prepare a report.

D. Construction Waste Disposal: Comply with waste disposal requirements in Division 01 Section 017419, "Construction Waste Management and Disposal".

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. Where applicable, clarify and update reviewed manual content to correspond to modifications and field conditions.

B. Format: Submit operations and maintenance manuals in the following format:
   a. PDF electronic file. Assemble each manual into a composite electronically-indexed file. Submit on digital media acceptable to Design Professional.
      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.
   b. One (1) paper copy. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Design Professional will return.

C. Initial Manual Submittal: Submit draft copy of each manual to Owner and Design Professional at least thirty (30) days before commencing demonstration and training. Design Professional, Owner, and Commissioning Agent 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 fifteen (15) days before commencing demonstration and training. Design Professional and Commissioning Agent will return copy with comments.
   1. Correct or modify each manual to comply with Design Professional's and Commissioning Agent’s comments. Submit copies of each corrected manual within fifteen (15) days of receipt of Design Professional's and Commissioning Agent’s comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Organization: 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 a 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 4-2008, "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 Construction Manager
7. Name and contact information for Design Professional
8. Name and contact information for Commissioning Agent
9. Names and contact information for major consultants to the Design Professional that designed the systems contained in the manuals.
10. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
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 upon 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 upon opening file.

F. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound, and labeled volumes.
1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf or post-type binders, in thickness necessary to accommodate contents, sized to hold 8½ by 11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
   a. If two (2) or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
   b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL", Project title or name and subject matter of contents. Indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
4. Supplementary Text: Prepared on 8½ by 11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
   a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.

b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:
1. Type of emergency
2. Emergency instructions
3. Emergency procedures

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
1. Fire
2. Flood
3. Gas leak
4. Water leak
5. Power failure
6. Water outage
7. System, subsystem, or equipment failure
8. Chemical release or spill

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:
1. Instructions on stopping
2. Shutdown instructions for each type of emergency
3. Operating instructions for conditions outside normal operating limits
4. Required sequences for electric or electronic systems
5. Special operating instructions and procedures

2.4 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 is 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.

2.5 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

2.6 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 AND DELIVERY
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 Division 01 Section 017839, "Project Record Documents".
G. Comply with Division 01 Section 017700, "Closeout Procedures" for schedule for submitting operation and maintenance documentation.
H. Include transmittal with all deliveries to Owner. Request receipt confirmation.

END OF SECTION

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 DEFINITIONS

A. Geospatial Data: Data or information that identifies the geographic location of features and boundaries in relation to the Owner's coordinate system.

1.4 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:
   1. Number of Copies: Submit copies of record Drawings as follows:
      a. Initial Submittal: Submit one (1) paper copy and PDF electronic files of marked-up record prints and one (1) set of plots from corrected record digital data files. Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
      b. Final Submittal: Submit one (1) paper copy, PDF electronic files, CADD and BIM of marked-up record prints, one (1) set of record digital data files, and three (3) sets of record digital data file plots. Plot each drawing file, whether or not changes and additional information were recorded.
      c. Architect will amend record CADD files for submission to Owner at completion of project.

B. Record Specifications: Submit one (1) paper copy and one (1) PDF copy of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit one (1) paper copy, one (1) PDF copy of each submittal, and one (1) CoBIE format.
   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: Refer to other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit one (1) paper copy of each submittal.

E. Reports: Submit written report indicating items incorporated in Project record documents concurrent with progress of the Work, including modifications, concealed conditions, field changes, product selections, and other notations incorporated.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one (1) set of marked-up paper copies of the Contract Drawings and Shop Drawings.
   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. Utilize 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. Format: As approved by Owner.
3. Format: Annotated PDF electronic file with comment function enabled.
4. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
5. Refer instances of uncertainty to Architect through Construction Manager for resolution.
6. Incorporate geospatial data collected during construction and installation to more accurately reflect as-built conditions.

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 and Construction Manager 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. Format: Annotated PDF electronic file with comment function enabled.
3. 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.
4. Identification: As follows:
   a. Project name
   b. Date
   c. Designation "PROJECT RECORD DRAWINGS"
   d. Name of Architect and Construction Manager
   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 a scanned PDF electronic file of the marked up paper copy of Specifications.

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 Specifications as a scanned PDF electronic file and CoBIE format of the marked up paper copy of Specifications.
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 record Specifications as a scanned PDF electronic file of the marked up paper copy of Specifications.
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 (1) copy of each submittal during the construction period for project record document purposes. Post changes and modifications to project record documents as they occur; do not wait until the 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 and Construction Manager's reference during normal working hours.

END OF SECTION

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

B. Related Sections:
   1. Divisions 02 through 49 Sections for specific requirements for demonstration and training for products in those Sections

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 utilizing manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

B. Qualification Data: For facilitator

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

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

1.4 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section 014000, "Quality Requirements", experienced in operation and maintenance procedures and training.

C. Pre-Instruction Conference: Conduct conference at Project site to comply with requirements in Division 01 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.

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 Design Professional.

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 modules. Assemble training modules into a training manual organized in coordination with requirements in Division 01 Section 017823, "Operations and Maintenance Data".

B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
   1. Schedule training with Owner, through Construction Manager, with at least seven days' advance notice.

D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.

E. 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.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Engage a qualified individual to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
   1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Video: Provide minimum 640 x 480 video resolution converted to format file type acceptable to Owner, on electronic media.
   1. Electronic Media: Read-only format compact disc acceptable to Owner, with commercial-grade graphic label.
   2. File Hierarchy: Organize folder structure and file locations according to project manual table of contents. Provide complete screen-based menu.
   3. File Names: Utilize file names based upon name of equipment generally described in video segment, as identified in Project specifications.
   4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the Equipment Demonstration and Training DVD that describes the following for each Contractor involved on the Project, arranged according to Project table of contents:
      a. Name of Contractor/Installer
      b. Business address
      c. Business phone number
      d. Point of contact
      e. E-mail address

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
   1. Film training session(s) in segments not to exceed fifteen (15) minutes.
      a. Produce segments to present a single significant piece of equipment per segment.
      b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
      c. Where a training session on a particular piece of equipment exceeds fifteen (15) minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.

D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
   1. Furnish additional portable lighting as required.
E. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.
F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.
G. Pre-produced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

END OF SECTION

SECTION 018114

SUSTAINABLE DESIGN 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 general requirements and procedures for compliance with USGBC LEED prerequisites and credits needed for Project to obtain LEED certification based on LEED ***[Level]*** certification based on ***[LEED Version]***. Other LEED prerequisites and credits needed to obtain LEED certification depend on material selections and may not be specifically identified as LEED requirements. Compliance with requirements needed to obtain LEED prerequisites and credits may be used as one criterion to evaluate substitution requests and comparable product requests.
   1. Additional LEED prerequisites and credits needed to obtain the indicated LEED certification depend on Design Professional's design and other aspects of Project that are not part of the Work of the Contract.
   2. A copy of the LEED Project checklist is attached at the end of this Section for information only.

B. Related Sections:
   1. Divisions 01 through 33 Sections for requirements specific to the work of each of these Sections.

1.3 DEFINITIONS

A. Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship". Certificates shall include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.

B. LEED: Leadership in Energy & Environmental Design.

C. Rapidly Renewable Materials: Materials made from plants that are typically harvested within a 10-year or shorter cycle. Rapidly renewable materials include products made from bamboo, cotton, flax, jute, straw, sunflower seed hulls, vegetable oils, or wool.

D. Regional Materials: Materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.

E. Regionally-Manufactured Materials: Materials that are manufactured within a radius of 500 miles from Project site. Manufacturing refers to the final assembly of components into the building product that is installed at Project site.

F. Regionally-Extracted and Manufactured Materials: Regionally-manufactured materials made from raw materials that are extracted, harvested, or recovered within a radius of 500 miles from Project site.

G. Recycled Content: The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.
   1. "Post-consumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.
   2. "Pre-consumer" material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it.

H. Recycled Content: The percentage by weight of constituents that have been recovered or otherwise diverted from the solid waste stream, either during the manufacturing process (pre-consumer), or after consumer use (post-consumer).
   1. Spills and scraps from the original manufacturing process that are combined with other constituents after a minimal amount of reprocessing for use in further production of the same product are not recycled materials.
   2. Discarded materials from one manufacturing process that are used as constituents in another manufacturing process are pre-consumer recycled materials.

1.4 SUBMITTALS

A. General: Submit sustainable submittals required by other Specification Sections.

B. Sustainable submittals are to be submitted with other submittals required by each section. If submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated sustainable requirements.

C. Project Materials Cost Data: Provide statement indicating total cost for building materials used for Project, excluding mechanical, electrical, and plumbing components, and specialty items such as elevators and equipment. Include statement indicating total cost for wood-based materials used for Project.

D. Sustainable Action Plans: Provide preliminary submittals within fourteen (14) days of date established for commencement of the Work indicating how the following requirements will be met:
   1. Waste management plan complying with Division 01 Section 017419, "Construction Waste Management and Disposal".
   2. Recycled Content: List of proposed materials with recycled content. Indicate cost, post-consumer recycled content, and pre-consumer recycled content for each product having recycled content.
   3. Regional Materials: List of proposed regional materials. Identify each regional material, including its source, cost, and the fraction by weight that is considered regional.
   4. Certified Wood: List of proposed certified wood products. Indicate each product containing certified wood, including its source and cost of certified wood products.
   5. Indoor Air Quality: Construction indoor-air-quality management plan.

E. Sustainable Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with action plans for the following:
   1. Waste reduction progress reports complying with Division 01 Section 017419, "Construction Waste Management and Disposal".
   2. Recycled content
   3. Regional materials
   4. Certified wood products

F. Sustainable Documentation Submittals:
   1. Product data and wiring diagrams for sensors and data collection system used to provide continuous metering of building energy consumption performance over time.
   2. Recycled Content: Product data and certification letter indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.
   3. Regional Material: Product data for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
   4. Certified Wood: Product data and chain-of-custody certificates for products containing certified wood. Include statement indicating cost for each certified wood product.
   5. Indoor Air Quality During Construction:
      a. Construction indoor air quality management plan
      b. Product data for temporary filtration media
      c. Product data for filtration media used during occupancy
      d. Construction Documentation: Six (6) photographs at three (3) different times during the construction period, along with a brief description of the SMACNA approach employed, documenting implementation of the indoor air quality management measures, such as protection of ducts and on-site stored or installed absorptive materials.
   6. Indoor Air Quality Prior to Occupancy:
      a. Signed statement describing the building air flush-out procedures, including the dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.
      b. Product data for filtration media used during flush-out and during occupancy.
      c. Report from testing and inspecting agency, indicating results of indoor air quality testing and documentation shows compliance with indoor air quality testing procedures and requirements.
   7. Adhesives and Sealants: Product data for adhesives and sealants used inside the weatherproofing system indicating VOC content of each product used. Indicate VOC content in g/L calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   8. Paints and Coatings: Product data for paints and coatings used inside the weatherproofing system indicating chemical composition and VOC content of each product used. Indicate VOC content in g/L calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   9. Urea Formaldehyde Prohibition: Product data for products containing composite wood or agrifiber products or wood glues indicating that they do not contain urea-formaldehyde resin.

1.5 QUALITY ASSURANCE

A. Sustainability Coordinator: Engage an experienced LEED-Accredited Professional to coordinate sustainable requirements. Sustainability Coordinator may also serve as waste management coordinator.

PART 2 - PRODUCTS

2.1 RECYCLED CONTENT OF MATERIALS

A. Cost of post-consumer recycled content plus one-half of pre-consumer recycled content of an item shall be determined by dividing weight of post-consumer recycled content plus one-half of pre-consumer recycled content in the item by total weight of the item and multiplying by cost of the item.

B. Do not include mechanical and electrical components in the calculation.

2.2 REGIONAL MATERIALS

A. Provide 20 percent of building materials (by cost) that are regional materials.

B. Provide 20 percent of building materials (by cost) that are regionally manufactured materials.

C. Provide 10 percent of building materials (by cost) that are regionally extracted and manufactured materials.

2.3 CERTIFIED WOOD

A. Provide a minimum of 50 percent (by cost) of wood-based materials that are produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship".

1. Wood-based materials include, but are not limited to, the following materials when made from wood, engineered wood products, or wood-based panel products:
    a. Rough carpentry
    b. Miscellaneous carpentry
    c. Heavy-timber construction
    d. Wood decking
    e. Metal plate-connected wood trusses
    f. Structural glued-laminated timber
    g. Finish carpentry
    h. Architectural woodwork
    i. Wood paneling
    j. Wood veneer wall covering
    k. Wood flooring
    l. Wood lockers
    m. Wood cabinets
    n. Furniture

2.4 LOW-EMITTING MATERIALS

A. For field applications that are inside the weatherproofing system, use adhesives and sealants that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Wood Glues: 30 g/L
2. Metal-to-Metal Adhesives: 30 g/L
3. Adhesives for Porous Materials (Except Wood): 50 g/L
4. Subfloor Adhesives: 50 g/L
5. Plastic Foam Adhesives: 50 g/L
6. Carpet Adhesives: 50 g/L
7. Carpet Pad Adhesives: 50 g/L
8. VCT and Asphalt Tile Adhesives: 50 g/L
9. Cove Base Adhesives: 50 g/L
10. Gypsum Board and Panel Adhesives: 50 g/L
11. Rubber Floor Adhesives: 60 g/L
12. Ceramic Tile Adhesives: 65 g/L
13. Multipurpose Construction Adhesives: 70 g/L
14. Fiberglass Adhesives: 80 g/L
15. Contact Adhesive: 80 g/L
16. Structural Glazing Adhesives: 100 g/L
17. Wood Flooring Adhesive: 100 g/L
18. Structural Wood Member Adhesive: 140 g/L

19. Special Purpose Contact Adhesive (contact adhesive that is used to bond melamine covered board, metal, unsupported vinyl, Teflon, ultra-high molecular weight polyethylene, rubber or wood veneer 1/16 inch or less in thickness to any surface): 250 g/L.
20. Top and Trim Adhesive: 250 g/L
21. Plastic Cement Welding Compounds: 350 g/L
22. ABS Welding Compounds: 400 g/L
23. CPVC Welding Compounds: 490 g/L
24. PVC Welding Compounds: 510 g/L
25. Adhesive Primer for Plastic: 650 g/L
26. Sheet Applied Rubber Lining Adhesive: 850 g/L
27. Aerosol Adhesive, General-Purpose Mist Spray: 65 percent by weight
28. Aerosol Adhesive, General-Purpose Web Spray: 55 percent by weight
29. Special-Purpose Aerosol Adhesive (All Types): 70 percent by weight
30. Other Adhesives: 250 g/L
31. Architectural Sealants: 250 g/L
32. Non-Membrane Roof Sealants: 300 g/L
33. Single-Ply Roof Membrane Sealants: 450 g/L
34. Other Sealants: 420 g/L
35. Sealant Primers for Nonporous Substrates: 250 g/L
36. Sealant Primers for Porous Substrates: 775 g/L
37. Modified Bituminous Sealant Primers: 500 g/L
38. Other Sealant Primers: 750 g/L

B. For field applications that are inside the weatherproofing system, use paints and coatings that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and the following chemical restrictions:
1. Flat Paints, Coatings, and Primers: VOC not more than 50 g/L
2. Non-Flat Paints, Coatings, and Primers: VOC not more than 150 g/L
3. Anticorrosive and Antirust Paints Applied to Ferrous Metals: VOC not more than 250 g/L
4. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L
5. Clear Wood Finishes, Lacquers: VOC not more than 550 g/L
6. Floor Coatings: VOC not more than 100 g/L
7. Shellacs, Clear: VOC not more than 730 g/L.
8. Shellacs, Pigmented: VOC not more than 550 g/L
9. Stains: VOC not more than 250 g/L
10. Flat Interior Topcoat Paints: VOC not more than 50 g/L
11. Non-Flat Interior Topcoat Paints: VOC not more than 150 g/L
12. Anticorrosive and Antirust Paints Applied to Ferrous Metals: VOC not more than 250 g/L
13. Clear Wood Finishes, Varnishes and Sanding Sealers: VOC not more than 350 g/L
14. Clear Wood Finishes, Lacquers: VOC not more than 550 g/L
15. Floor Coatings: VOC not more than 100 g/L
16. Shellacs, Clear: VOC not more than 730 g/L
17. Shellacs, Pigmented: VOC not more than 550 g/L
18. Stains: VOC not more than 250 g/L
19. Primers, Sealers, and Undercoats: VOC not more than 200 g/L
20. Dry-Fog Coatings: VOC not more than 400 g/L
21. Zinc-Rich Industrial Maintenance Primers: VOC not more than 340 g/L
22. Pretreatment Wash Primers: VOC not more than 420 g/L
23. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).

C. Urea Formaldehyde Prohibition: Do not use composite wood or agrifiber products or adhesives that contain urea-formaldehyde resin.

PART 3 - EXECUTION

3.1 REFRIGERANT AND CLEAN-AGENT FIRE-EXTINGUISHING-AGENT REMOVAL

A. Remove CFC-based refrigerants from existing HVAC&R equipment indicated to remain and replace with refrigerants that are not CFC-based. Replace or adjust existing equipment to accommodate new refrigerant as described in Division 23 Section ***[Number] [Title]***.

B. Remove clean-agent fire-extinguishing agents that contain HCFCs or halons and replace with agent that does not contain HCFCs or halons. See Division 21 Section ***[Number]***, “Clean-Agent Fire Extinguishing Systems" for additional requirements.

3.2 MEASUREMENT AND VERIFICATION

A. Implement measurement and verification plan consistent with [Option B: Energy Conservation Measure Isolation] [Option D: Calibrated Simulation, Savings Estimation Method 2] in the EVO's "International Performance Measurement and Verification Protocol (IPMVP) Volume III: Concepts and Options for Determining Energy Savings in New Construction".

B. If not already in place, install metering equipment to measure energy usage. Monitor, record, and trend log measurements.

C. Evaluate energy performance and efficiency by comparing actual to predicted performance.

D. Measurement and verification period shall cover at least one year of post-construction occupancy.

3.3 CONSTRUCTION WASTE MANAGEMENT

A. Comply with Division 01 Section 015639, “Construction Waste Management and Disposal".

3.4 CONSTRUCTION INDOOR-AIR-QUALITY MANAGEMENT

A. Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction".

1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Division 01 Section "Temporary Facilities and Controls", install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
2. Replace all air filters immediately prior to occupancy.

B. Comply with the following requirements:

1. Air-Quality Testing:
   a. Conduct baseline indoor-air-quality testing, after construction ends and prior to occupancy, using testing protocols consistent with the EPA's "Compendium of Methods for the Determination of Air Pollutants in Indoor Air” and as additionally detailed in the USGBC's ***[LEED Version]***: Reference Guide".
   b. Demonstrate that the contaminant maximum concentrations listed below are not exceeded:
      1) Formaldehyde: 50 ppb
      2) Particulates (PM10): 50 micrograms/cu. m
      3) Total Volatile Organic Compounds (TVOC): 500 micrograms/cu. m
      4) 4-Phenylcyclohexene (4-PH): 6.5 micrograms/cu. m
      5) Carbon Monoxide: 9 ppm and no greater than 2 ppm above outdoor levels
   c. For each sampling point where the maximum concentration limits are exceeded, conduct additional flush-out with outside air and retest the specific parameter(s) exceeded to indicate the requirements are achieved. Repeat procedure until all requirements have been met. When retesting non-complying building areas, take samples from same locations as in the first test.
   d. Air-sample testing shall be conducted as follows:
      1) All measurements shall be conducted prior to occupancy but during normal occupied hours and with building ventilation system starting at the normal daily start time and operated at the minimum outside air flow rate for the occupied mode throughout the duration of the air testing.
      2) Building shall have all interior finishes installed including, but not limited to, millwork, doors, paint, carpet, and acoustic tiles. Non-fixed furnishings such as workstations and partitions are encouraged, but not required, to be in place for the testing.
      3) Number of sampling locations will vary depending on the size of building and number of ventilation systems. For each portion of building served by a separate ventilation system, the number of sampling points shall not be less than one per 25,000 sq. ft. or for each contiguous floor area, whichever is larger, and shall include areas with the least ventilation and greatest presumed source strength.
      4) Air samples shall be collected between 3-feet and 6-feet from the floor to represent the breathing zone of occupants, and over a minimum four (4) hour period.

END OF SECTION

SECTION 019113

GENERAL COMMISSIONING 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.

B. OPR and BoD documentation are included by reference for information only.

1.2 SUMMARY

A. Section includes general requirements that apply to implementation of commissioning without regard to specific systems, assemblies, or components.

1.3 DEFINITIONS

A. BoD: Basis of Design. A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

B. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

C. CxA: Commissioning Authority.

D. OPR: Owner's Project Requirements. A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

E. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 COMMISSIONING TEAM

A. Members Appointed by Contractor(s): Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action. The commissioning team shall consist of, but not be limited to, representatives of each Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.

B. Members Appointed by Owner:

1. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.
2. Representatives of the facility user and operation and maintenance personnel.
3. Architect and engineering design professionals.

1.5 OWNER'S RESPONSIBILITIES

A. Provide the OPR documentation to the Design Professional, CxA and Contractor for information and use.

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

C. Provide the BoD documentation, prepared by Design Professional and approved by Owner, to the CxA and Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

1.6 CONTRACTOR'S RESPONSIBILITIES

A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:

1. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
2. Cooperate with the CxA for resolution of issues recorded in the Issues Log.
3. Attend commissioning team meetings held on a monthly basis.
4. Integrate and coordinate commissioning process activities with construction schedule.
5. Review and accept construction checklists provided by the CxA.
6. Complete electronic construction checklists as Work is completed and provide to the CxA.
7. Review and accept commissioning process test procedures provided by the CxA.

8. Complete commissioning process test procedures.

1.7 CxA'S RESPONSIBILITIES

A. Organize and lead the commissioning team
B. Provide commissioning plan
C. Convene commissioning team meetings
D. Provide Project-specific construction checklists and commissioning process test procedures.
E. Verify the execution of commissioning process activities using random sampling. The sampling rate may vary from 1 to 100 percent. Verification will include, but is not limited to, equipment submittals, construction checklists, training, operating and maintenance data, tests, and test reports to verify compliance with the OPR. When a random sample does not meet the requirement, the CxA will report the failure in the Issues Log.
F. Prepare and maintain the Issues Log
G. Prepare and maintain completed construction checklist log
H. Witness systems, assemblies, equipment, and component startup
I. Compile test data, inspection reports, and certificates; include them in the systems manual and commissioning process report.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 02 41 19
SELECTIVE STRUCTURE DEMOLITION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

A. Demolition work shall include all wrecking and removal of existing work as required by all trades as required to accommodate the new construction and as shown on the Drawings.

B. Related Section: Section **02 41 21** - Work at Existing Facility

1.03 REGULATORY REQUIREMENTS

A. Conform to applicable code for demolition of structure, safety of adjacent structures, dust control, service utilities, and discovered hazards.

1.04 SALVAGE AND RUBBISH

A. Salvage: All materials, equipment, etc., designated on the Drawings to be salvaged or reused, shall be carefully removed, protected and stored until time to be reinstalled or delivered to the Owner for storage.
   1. Items to be retained, stored and re-used by the Contractor.
      a. Fire Extinguisher/Cabinet.
      b. Unblemished mechanical diffusers.
      c. Unblemished light fixtures.
   2. Remove the following scheduled materials and equipment to be retained by Owner and as noted on the Drawings:
      a. Locking hardware
      b. Smoke detectors and pull stations
      c. Signage as required by the Architect
      d. Light fixtures.

B. Rubbish: All material, equipment, etc., resulting from demolition work and not designated for salvage, shall become the property of the Contractor, and the Contractor shall remove and disposed of same.

C. Contractor to coordinate with the Owner for the selection of and storage location of salvaged items to be retained by the Owner.

PART 2 PRODUCTS

2.01 MATERIALS

NOT USED

PART 3 EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Bidders shall, before submitting a proposal, visit and examine the existing building to satisfy themselves of the actual nature and scope of the work to be done and all the details involved.
   1. The submittal of a proposal shall be taken as evidence that such an examination has been made and the various features noted. Later claims for extra compensation on account of additional labor, materials and/or equipment required for, or on account of any difficulties encountered, which should have been seen or could have been anticipated will not be recognized, and all such items shall be properly disposed of by the Contractor at his own expense.

B. Notify adjacent Owners of work which may affect their property, potential noise, utility outage, or disruption. Coordinate with Owner.

C. Protect existing landscaping materials and structures which are not to be demolished.

D. Erect and maintain weatherproof closures for exterior openings.

F. Protect existing items which are not indicated to be removed.

3.02 DEMOLITION REQUIREMENTS

A. Conduct demolition to minimize interference with adjacent building areas.

B. Conduct operations with minimum interference to public or private accesses.

C. Do not close or obstruct roadways without permits. Maintain protected means of egress and access to all required exits from existing structures to a public way beyond the area of construction at all times. Provide overhead protection when exit passageway extends through areas of construction.

D. Whenever it is necessary to shut down electrical, mechanical or plumbing systems affecting any portion of the building still in use by the Owner, the work shall be done in accordance with Section 02 41 21 -Work at Existing Facility.

E. Wherever facing is removed from exterior walls on existing building, the exterior faces shall be made waterproof by approved means to protect interior portions of existing building until permanent construction is installed.

F. Unless specifically noted otherwise, where new flooring is scheduled to be installed, the Contractor shall remove the existing flooring down to bare concrete regardless of the number of layers of existing flooring.

3.03 DEMOLITION

A. Disconnect and remove utilities.

B. Demolish components in an orderly and careful manner.

C. Remove all non-functioning items above ceiling, wiring, ductwork, etc.

D. Protect existing supporting structural members.

E. Shoring: The Contractor shall properly shore up all existing elements requiring temporary support caused by removal of existing elements. Such shoring shall be of a character and strength as to properly support the elements during construction operations. Full responsibility for the successful shoring and removal shall be upon the Contractor and any damage resulting from these operations shall be repaired at the Contractor's expense to the satisfaction of the Architect.

3.04 PATCHING

A. Where demolition work or cutting of existing construction is performed, the surface shall be patched with like materials to match existing surfaces.

3.05 CLEAN UP

A. Remove demolished materials from site as work progresses to maintain clean construction area.

B. Leave areas of work in clean condition.

END OF SECTION

SECTION 02 41 21
WORK AT EXISTING FACILITY

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Articles and portions of articles of the General Conditions and Supplementary Conditions not amended, supplemented or superseded by these General Requirements (Division 1) shall remain in effect.

1.02 SECTION INCLUDES

A. Furnish all labor, materials, services, equipment, and appliances required in connection with the work at existing facility as indicated on the Drawings and as described herein.
   1. Scheduling of Construction
   2. Control of Dust, Odor, Vibration and Other Contaminants/Irritants
   3. Safety and Security
   4. Existing Conditions
   5. Use of Existing Facility

1.03 GENERAL

A. The intent is to minimize the impact of the construction activities on the occupied areas of the building or impact on Owner's operations per Paragraph 3.04 below.

B. The Contractor shall meet with the Owner as needed to assure compliance with these standards. The Contractor shall provide labor, materials, equipment, etc. as required to assure compliance.

C. The Contractor will respond to the Owner immediately, and in any case within sixty (60) minutes, if the Owner determines that the Construction activity is impacting or potentially could impact patient care in occupied areas of the building. If the Contractor does not respond immediately, the Owner will perform corrective measures and the cost, as determined by the Owner, will be deducted from the Contract amount by Change Order.

D. The Owner’s designated representative for matters related to this Section will be determined at the Pre-Construction conference.

PART 2 EXECUTION

2.01 SCHEDULING OF CONSTRUCTION

A. Existing facilities must function at all times during construction activities and the Contractor shall do whatever is necessary to ensure continuous operation as outlined below.

B. The start of each phase of construction must be approved by the Owner prior to beginning work in that phase.

C. The Owner will vacate the designated areas at the appropriate time. All other adjacent areas will remain occupied and must remain in operation.

D. The Owner reserves seven (7) days to vacate prior to commencement of each phase. The Contractor may resume work earlier if notified by the Owner that the moving process is complete.

E. Work Plan and Outage Request: All work that could impact the Owner's facilities and operation, including mechanical, plumbing, and electrical systems, must be scheduled with the Owner to minimize the impact on the Owner's facility and operations.
   1. The Contractor shall submit a “Work Plan Approval Request” form for all work to be performed outside the designated construction area at least two (2) weeks in advance of the proposed portion of work. Refer to the form at the end of this Section.
   2. The Contractor shall submit an “Outage Request” form at least two (2) weeks in advance of the proposed outage. Refer to the form at the end of this Section.

3. The Contractor shall research in detail each piece of work or system to be affected and present the proposed plan of accomplishing the “work” without impacting the Owner's facilities and operations to the Owner for review and approval along with the work plan or outage request.
4. The Contractor shall provide and install temporary wiring, lighting, ductwork, spot coolers, etc. as necessary to facilitate the continued operation of the facility and remove such temporary measures at the conclusion of the work.
5. The Contractor shall perform the work so that only a small area will be out of use at any one time and all work completed within any given small area before commencing with the next small area. The intent is to minimize the impact to the facility.
6. The Contractor will perform work at night or on weekends if necessary to allow the facility to continue to operate.

2.02 CONTROL OF DUST, ODOR, VIBRATION AND OTHER CONTAMINANTS / IRRITANTS

A. All penetrations into the construction area must be sealed and windows closed.

B. Debris removal from the construction area must be completed by a predetermined route at times approved by the Owner. Debris shall be transported in clean carts with tight-fitting covers. The Contractor shall follow each cart to assure the route is perpetually clean.

C. All supply air ductwork to the construction area, and all return air and exhaust air ductwork from the construction area shall be identified, and addressed as required, to prevent dust, odors, fumes and other contaminants from being transferred to occupied areas of the facility. All supply air outlets and all return air inlets and/or ducts serving the construction area should be capped. The respective air handling unit(s) and return air fan(s) should be re-balanced (re-sheaved) as required to maintain existing airflows to all other areas served by the same unit(s), without adversely affecting the intended space pressure differentials. Where it is not feasible to cap all the existing air outlets and inlets due to the duct system layout or unit minimum airflow requirements, the flow of air will be allowed into and out of the construction area, provided all openings are protected with HEPA filters. In any case, it is imperative that all areas adjacent to the construction areas have space pressure differentials maintained. All supply air, outside air, return air and exhaust ducts running through the construction area shall be sealed air tight.

D. Negative pressure must be always maintained within the project site using negative air fan units fitted with filters. In small remote areas of work negative air pressure may not be required, but the intent to eliminate the spread of dust and other contaminates including odors must be always met in all locations.

E. The Contractor shall take all precautions necessary to ensure that no dust, odors, fumes or other contaminants generated because of any construction activities are drawn into any air intakes into occupied areas.

F. The Contractor shall take all precautions necessary to minimize the noise and vibration that is generated on the jobsite and could potentially be transferred to the building structure or to other spaces within the facility. All work hours must be pre-approved by the Owner so that he can confirm that activities in surrounding adjacent areas will not be adversely affected by the anticipated noise and/or vibration that may be generated by the planned construction activities.

G. If the Contractor releases and/or allows water, sewage, objectionable substances, contaminants or other such materials into the facility, the Contractor shall respond immediately to clean up and restore the area to its previous condition. When required by the Owner, the Contractor shall employ, at the Contractor’s expense, a third-party agency selected by the Owner to inspect the area to determine if it is acceptable to reoccupy. The third-party agency will be determined at the Pre-Construction Conference.

2.03 SAFETY OF OWNER'S OCCUPANTS AND SECURITY

A. Maintain exits as required by all Authorities Having Jurisdiction. Exit paths, including corridor, stairs, etc., shall be left fully functional with temporary safeguards, lighting, etc. at end of each workday. If stairs are part of the work, only one (1) flight of stairs shall be worked on at a time.

B. Provide signs at construction entrances, and other locations as necessary to protect occupants of the facility. Wording shall be approved by the Owner in advance.

C. Comply with Owner's requirements for use of open flame. Obtain a burn permit or other approval from the Owner before using any open flame.

D. Contractor shall have a copy of the MSDS sheet for each product used. It shall be made readily available for review with the Owner if needed. No products should be used that could cause an objectionable odor as determined by the Owner.

E. No use of tobacco products is allowed anywhere on campus, inside or outside of buildings.

F. No consumption of alcoholic beverages or illegal drugs of any kind will be permitted on premises. Any person caught must be removed from the premises.

2.04 EXISTING CONDITIONS

A. It is the intent of the contract documents that the Contractor inspects the job site prior to bidding and be familiar with all existing conditions. THE COST OF THE WORK REQUIRED TO ACCOMMODATE THE EXISTING CONDITIONS SHALL BE INCLUDED IN THE BID PROPOSAL.

B. Protect existing building as required from damage, moisture and dust. Provide materials as required to protect existing building finishes and equipment. At completion of Contract, existing building items shall be restored, by means of repair or replacement, to previous condition or better.

C. Any item whether shown on the drawings or not, that must remain for the facility to operate properly, but whose location is in conflict with the new construction, shall be removed, relocated and reconnected as necessary to accommodate the new work at no additional cost. Furthermore, the Contractor shall be responsible to research and determine the appropriate way and method to relocate and reconnect the item. The Contractor shall submit his solution to the Architect for approval. The Contractor alone will be responsible for the cost of the work shown, indicated or reasonably inferred as being necessary to produce the indicated results.

D. Coordinate the work with the Mechanical and Electrical Divisions of the specifications. Determine which items and equipment are to remain, which are to be relocated and/or removed, and perform all work consistent with the indicated final result.

E. Prior to construction, inspect all areas adjacent to the proposed "work" including route to construction area; prepare a photographic record of existing damaged conditions and their locations, including, but not limited to: walls, ceilings, floors, doors, etc. As part of the work, all items shall be restored to its previous condition or damaged items not represented by photographic record that are within the areas effected by construction, shall be repaired to "like new" condition.

F. Existing floors shall be leveled in accordance with Section 03 54 00 - Self Leveling Underlayment.

G. In existing rooms and spaces where work is being done, the existing finishes adjacent to the new or remodeled work shall be cleaned or refinished to "like new" condition to the nearest inside corner or as indicated on Drawings.

H. In locations where demolition and or remodel work is being done, unfinished surfaces resulting from such work shall be refinished to match existing adjacent finishes.

2.05 USE OF EXISTING FACILITY

A. All material shall be stored within the building in the area under construction or in a designated storage area on site.

B. All construction traffic, deliveries, etc. shall be limited to routes and times allowed by the Owner to reduce the effect of the construction on the operation of the facility.

C. Contractors will be required to wear an Owner-approved badge when working at the facility in areas outside of the designated construction area.

D. Toilets: The Contractor shall NOT use the existing toilets in the facility.

UNIVERSITY OF NORTH TEXAS
Discovery Park H Wing Research Labs

WORK PLAN APPROVAL REQUEST

REQUEST NO._____

Date submitted to Owner:_____ Approval needed by date:_____

Proposed date and time to start work Date:_____Time:_____A.M. / P.M.

Duration of work:_____

Location of work (room names, numbers, wing no., etc. or attach drawing if necessary):

_____

_____

Area affected (room names, numbers, wing no., etc. or attach drawing if necessary):

_____

_____

Utility system affected (attach "Outage Request" form):

_____

_____

Description of work:_____

_____

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_____

Potential impact to facilities and operation:_____

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_____

_____

Proposed plan to accomplishing the work and not impact facilities and operations:

_____

_____

_____

_____

General Contractor Signature:_____ Date:_____

Owner Comments: ☐ Approved ☐ Approved as Noted ☐ Correct and Resubmit

_____

_____

_____

_____

Owner's signature:_____ Date:_____

UNIVERSITY OF NORTH TEXAS
Discovery Park H Wing Research Labs

OUTAGE REQUEST

REQUEST NO._____

Date submitted to Owner:_____ Approval needed by date:_____

Proposed date and time to start work Date:_____Time:_____A.M. / P.M.

Duration of work:_____

Utility system affected:_____

_____

_____

Location of work (room names, numbers, wing no., etc. or attach drawing if necessary):

_____

_____

Area affected (room names, numbers, wing no., etc. or attach drawing if necessary):

_____

_____

Description of work:_____

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Potential impact to facilities and operation:_____

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Proposed plan to accomplishing the work and not impact facilities and operations:

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General Contractor signature:_____ Date:_____

Owner Comments: ☐ Approved ☐ Approved as Noted ☐ Correct and Resubmit

_____

_____

_____

Owner's signature:_____ Date:_____

END OF SECTION

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

A. Rough carpentry work includes sheathing, blocking, shoring, roof curbs, and wood furring.

B. Related Sections:
   1. Section 03 10 10 - Concrete Forming
   2. Division 8 - Openings

1.03 INDUSTRY STANDARDS

A. References: Some products and execution are specified in this Section by reference to published specifications or standards of the following with respective abbreviations used:
   1. American Plywood Association (APA)
   2. American Wood Preservers Association (AWPA)
   3. American Society for Testing and Materials (ASTM)
   4. Southern Pine Inspection Bureau (SPIB)
   5. Underwriters Laboratories (UL)
   6. U.S. Product Standards (USPS)
   7. Western Wood Products Association (WWPA)

1.04 COORDINATION

A. Coordinate locating of Nailers, furring, grounds and similar supports for other trades so that installation of finish work may be properly executed. Before starting installation of supports, carefully check Drawings to ensure locating of supports.

1.05 PRODUCT HANDLING

A. Protect materials from weather when delivered to site, immediately place under cover and adequately protect from weather. Do not store or erect kiln-dried material in wet or damp portions of buildings or in areas where masonry, drywall or similar work is to be executed until such work has been completed and has become reasonably dry.

PART 2 PRODUCTS

2.01 LUMBER MATERIALS

A. Moisture Content of Lumber: Maximum moisture content for lumber products shall be 19% on air dried stock, and 15% maximum on kiln-dried (KD) stock.

B. Dressing Lumber: Surface lumber four sides (S4S) unless specified otherwise for particular products.

C. Framing Lumber: Various materials for framing shall be of sizes shown and shall conform to Grading Standards of SPIB and WWPA.

D. Species and Grades of Lumber:
   1. For structural wood framing see notes on Drawings.
   2. Furring, Ground, Blocking, Wood Bucks and Wood Nailers: SPIB grade marked No. 2 Grade Southern Yellow Pine, S4S, or maybe WWPA grade marked Standard Grade Douglas Fir.

2.02 SHEET MATERIALS

A. Plywood Materials: Softwood plywood shall conform to requirements of U.S. Product Standard PS 1-74, Construction and Industrial. All plywood used for sheathing, used as back up to

roofing membrane or which has any edge or surface permanently exposed to weather shall be "exterior" type. Plywood shall be APA-rated sheathing of American manufacture.

2.03 LUMBER TREATMENT

A. Fire-Retardant Treated Wood Products: Fire-retardant treated wood products shall be pressure-impregnated with fire-retardant chemicals and shall bear the Underwriter's Laboratories label indicating a flame spread not exceeding 25 with no evidence of significant progressive combustion when tested for thirty (30) minutes in accordance with "Methods of Testing for Surface Burning Characteristics of Building Materials" ASTM E84.
   1. Moisture Content: Materials shall be dried after treatment to an average moisture content of 19%.
   2. Locations: All lumber and plywood used for blocking, Nailers, bracing, etc. above ceilings, within a part of interior partitions, and framing.

2.04 ROUGH HARDWARE

A. Anchors, bolts, screws and spikes shall be of proper types and sizes to support the work and to draw the members into place and hold them securely. Bolt heads and nuts bearing on wood shall have standard washers.

B. Explosive or powder-driven fasteners may be used.

C. Metal fasteners to secure wood grounds and blocking to masonry and concrete shall be of the type best suited to the conditions and spaced not more than 16" o.c. Wood plugs and nailing blocks are not acceptable.

D. Nails shall be of the sizes and types intended for the particular use.

E. Rough hardware exposed to the weather or embedded in exterior masonry and concrete walls or slabs shall be galvanized.

PART 3 EXECUTION

3.01 INSTALLATION

A. Framing:
   1. General:
      a. Members shall be properly framed, closely fitted, accurately set and rigidly secured in place. Shims shall not be used for leveling on wood or metal bearings, but slate or tile shims may be used for leveling on masonry and concrete.
      b. All framing shall be closely fitted, accurately set to the required lines and levels, and securely spiked and bolted in place. Provide all bracing required to obtain rigid structures.

B. Wood Grounds:
   1. Location: Install permanent and temporary wood grounds as indicated for proper execution of work of all trades. Remove temporary grounds when they are no longer required.
   2. Fastening: Except as otherwise required for special locations, form grounds of kiln-dried southern yellow pine, 1-1/2" wide and of thickness to properly align related items of work. Securely fasten grounds into position by means of powder-actuated fasteners, annealed wire, nails, brads, bolts or other methods that will provide maximum results.
   3. Coordination: Coordinate locations, sizes and fastenings of grounds with work of other trades. When grounds are to provide backing for fastening of grilles, fixture, louvers and similar items of work, exercise care in installation of grounds to provide for correct installation of those other items.

C. Wood Blocking:
   1. Location: Install all wood blocking as required to provide anchorage for other materials. Form shapes and sizes as indicated or as may be required to accomplish particular installation. Form blocking of sizes shown or of minimum 2" thick material.

2. Steel: Blocking in conjunction with steel work shall be bolted to steel with bolts, washers and nuts, countersunk where required.
3. Anchorage: Wedge, anchor and align blocking to provide rigid and secure installation of both blocking and other related work. Where bolt sizes and spacing are not specifically called out, use not less than 3/8" bolts at 48" o.c. staggered.
4. Roofing: Form blocking in conjunction with roofs to shapes as detailed. Anchor with countersunk bolts, washers and nuts.

D. Shoring: Provide shoring where required and brace and maintain it until permanent construction is completed.

3.02 CLEANING

A. At completion of work, remove all excess materials and all debris resulting from operations of work of this Section. Leave the entire work in neat, clean condition.

END OF SECTION

SECTION 06 41 16

PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Plastic-laminate-clad architectural cabinets.
   2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-clad architectural cabinets that are not concealed within other construction.

1.2 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Section 08 71 00 "Door Hardware" to manufacturer of architectural cabinets; coordinate Shop Drawings and fabrication with hardware requirements.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   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:
   1. Include plans, elevations, sections, and attachment details.
   2. Show large-scale details.
   3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
   4. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.

C. Samples for Initial Selection: For each type of exposed finish.

D. Samples for Verification: For the following:
   1. Plastic Laminates: 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish required.
      a. Provide one sample applied to core material with specified edge material applied to one edge.
   2. Thermoset Decorative Panels: 8 by 10 inches (200 by 250 mm), for each color, pattern, and surface finish.
      a. Provide edge banding on one edge.
   3. Corner Pieces:
      a. Cabinet-front frame joints between stiles and rails and at exposed end pieces, 18 inches (450 mm) high by 18 inches (450 mm) wide by 6 inches (150 mm) deep.
      b. Miter joints for standing trim.
   4. Exposed Cabinet Hardware and Accessories: One full-size unit for each type and finish.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Product Certificates: For each type of product.
   1. Composite wood products.
   2. Thermoset decorative panels.
   3. High-pressure decorative laminate.
   4. Adhesives.

C. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

B. Installer Qualifications: Manufacturer of products.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article in this specification.

1.8 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 between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 43 and 70 percent during the remainder of the construction period.

B. 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/concealed by construction and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.
   1. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

B. Architectural Woodwork Standards Grade: Premium.

C. Type of Construction: Frameless.

D. Door and Drawer-Front Style: Full overlay.

E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by 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. Pionite; a Panolam Industries International, Inc. brand.
      e. Wilsonart.
   2. Basis-of-Design Product: As scheduled.
   3. Substitutions: Provide in accordance with Section 01 25 00 “Substitution Procedures.”

F. Laminate Cladding for Exposed Surfaces:
   1. Horizontal Surfaces: Grade HGS.

2. Postformed Surfaces: Grade HGP.
3. Vertical Surfaces: Grade VGS.
4. Edges: Grade HGS.
5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.

G. Materials for Semi exposed Surfaces:
1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.
a. Edges of Plastic-Laminate Shelves: PVC edge banding, 0.12 inch (3 mm) thick, matching laminate in color, pattern, and finish.
b. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
c. For semi exposed 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: Thermoset decorative panels with PVC or polyester edge banding.
3. Drawer Bottoms: Thermoset decorative panels.

H. Dust Panels: 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers unless located directly under tops.

I. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.

J. Drawer Construction: Fabricate with exposed fronts fastened to sub front with mounting screws from interior of body.
1. Join sub fronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners.

K. 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 Scheduled on Drawings.

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
1. Wood Moisture Content: 5 to 10 percent.

B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
2. Particleboard: ANSI A208.1, Grade M-2.
3. Thermoset Decorative Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.3 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 08 71 00 "Door Hardware."

B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 120 degrees of opening, self-closing.

C. Back-Mounted Pulls: BHMA A156.9, B02011.

D. Wire Pulls: Back mounted, solid metal, 5 inches (127 mm) long, 2-1/2 inches (63.5 mm) deep, and 5/16 inch (8 mm) in diameter.

E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.

F. Shelf Rests: BHMA A156.9, B04013; metal.

G. Drawer Slides: BHMA A156.9.
1. Grade 1 and Grade 2: Side mounted.
a. Type: Full extension.
b. Material: Epoxy-coated steel with polymer rollers.
2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full -extension type; zinc-plated-steel ball-bearing slides.
3. For drawers not more than 3 inches (75 mm) high and not more than 24 inches (600 mm) wide,

provide Grade 2.

4. For drawers more than 3 inches (75 mm) high, but not more than 6 inches (150 mm) high and not more than 24 inches (600 mm) wide, provide Grade 1.
5. For drawers more than 6 inches (150 mm) high or more than 24 inches (600 mm) wide, provide Grade 1HD-100.
6. For computer keyboard shelves, provide Grade 1.
7. For trash bins not more than 20 inches (500 mm) high and 16 inches (400 mm) wide, provide Grade 1HD-100.

H. Door Locks: BHMA A156.11, E07121.

I. Drawer Locks: BHMA A156.11, E07041.

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

K. 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.

L. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.4 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood 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. 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 architectural 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.

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.

2.6 COUNTERTOP FABRICATION

A. Countertops: The methods of fabricating and fastening tops to case bodies shall conform to the Premium Grade requirements of the AWI Quality Standards, Section 1600C. To the fullest extent possible, the plastic laminate shall be shop-applied by pressure gluing. Field application of plastic laminate shall be held to a minimum.

1. Postformed: Countertops, back splash and rolled edge shall be postformed plastic laminate in one (1) piece with 3/4" radius at front edge of countertop, 3/8" radius cove between back splash and counter, and top of back splash to be a self-edged square corner.
2. Self-Edged: Countertop end splashes and millwork as scheduled or detailed on the Drawings. Joints between tops and splash shall be square.
3. T-Rubber Edge: Plastic laminate countertop to receive “T”-shaped rubber edging RT15 as manufactured by Edge Mold Products, Inc. and as detailed on the

Drawing.

4. Apply balanced backer sheet to underside.
5. Back Splash: Plastic laminate clad, 4" high from top of countertop to top of splash, unless detailed otherwise.
6. Overhang edge of countertop 1” at side of base cabinet that is not abutting a wall.

B. Full Back Splash: Plastic laminate clad on all exposed faces. No exposed fasteners acceptable.

C. End Splash: Plastic Laminate clad. Countertop and back splash to abut end splash. End splash top to align with top of back splash; front edge to align with front edge of countertop; bottom edge of splash to align with bottom edge of countertop.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.2 INSTALLATION

A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.

B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.

C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.

D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm) using concealed shims.
   1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
   2. Install cabinets without distortion so doors and drawers’ fit openings 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.
   3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches (400 mm) o.c..

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 architectural cabinets. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semi exposed surfaces.

END OF SECTION

SECTION 06 61 16
SOLID SURFACING FABRICATIONS

PART 1 GENERAL

1.01 SUMMARY

A. Solid surface fabrications for use at windowsills and thresholds.

B. Related Requirements:

1. Refer to Section 123661.16 “Solid Surfacing Countertops” for solid surface material countertops.

1.02 ACTION SUBMITTALS

A. Product Data: For solid surfacing materials.

B. Shop Drawings: Show materials, finishes, and edge profiles.

1. Show locations and details of joints.
2. Show direction of directional pattern, if any.

C. Samples for Verification: For the following products:

1. Solid surface material, 6 inches (150 mm) square.

1.03 CLOSEOUT SUBMITTALS

A. Maintenance Data: For solid surface material to be included in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.04 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate solid surfacing similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of solid surfacing.

PART 2 PRODUCTS

2.01 SOLID SURFACE MATERIALS

A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Affinity Surfaces; a brand of Domain Industries, Inc.
   b. E. I. du Pont de Nemours and Company.
   c. Formica Corporation.
   d. Wilsonart.
2. Substitutions: Provide in accordance with Section 012500 “Substitution Procedures.”
3. Type: Provide Standard type unless Special Purpose type is indicated.
4. Colors and Patterns: As scheduled.

B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.02 SOLID SURFACING FABRICATION

A. Fabricate solid surfacing according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Grade: Custom.

B. Solid surfacing: 1/2-inch- (12.7-mm-) thick, solid surface material.

C. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

D. Joints: Fabricate solid surfacing without joints.

2.03 INSTALLATION MATERIALS

A. Adhesive: Product recommended by solid surface material manufacturer.

B. Sealant for Solid surfacing: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates to receive solid surface material and conditions under which solid surfacings will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of solid surface.

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

3.02 INSTALLATION

A. Install solid surfacing level to a tolerance of 1/8 inch in 8 feet (3 mm in 2.4 m), 1/4 inch (6 mm) maximum. Do not exceed 1/64-inch (0.4-mm) difference between planes of adjacent units.

B. Fasten solid surfacing by screwing through corner blocks of base units into underside of solid surfacing. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match solid surfacing, form seams to comply with manufacturer's written instructions. Carefully dress joints smoothly, remove surface scratches, and clean entire surface.

C. Fasten sub tops to cabinets by screwing through sub tops into corner blocks of base cabinets. Shim as needed to align sub tops in a level plane.

D. Secure solid surfacing to sub tops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match solid surfacing, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

E. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION

SECTION 07 01 53
ROOF MODIFICATIONS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Modifications to the existing roof as required to accommodate the scope of the project including flashing and sheet metal.

1.02 SUBMITTALS

A. Product Data: Manufacturers' published specifications and installation instructions and details the modification of the existing roofing system.

B. Certificates:

1. Applicator is approved by roofing manufacturer and can obtain the ten (10) year warranty.

C. Shop Drawings: Show plan of proposed roof modifications. Show cants, crickets, blocking, roof membrane, etc. Show large-scale details of each condition.

D. Maintenance Data: Manufacturer's maintenance instructions and Owner's guide.

1.03 QUALITY ASSURANCE

A. Roofing Sub-Contractor Qualifications: Submit written evidence that roofing sub-contractor is an approved roofer by the membrane material manufacturer providing the roof warranty. The roofing subcontractor must be approved by the Owner.

B. System: All components must be by the same manufacturer who is providing the warranty, to ensure the entire roof system is covered by the warranty.

C. References:

1. National Roofing Contractors Association (NRCA)
2. American Society for Testing and Materials (ASTM)
3. Underwriters Laboratories, Inc. (UL)

1.04 ENVIRONMENTAL REQUIREMENTS

A. Do not apply roofing membrane during inclement weather or to damp or frozen deck surface.

B. Minimum Ambient Temperature for Application: No roofing material or roof insulation may be installed when temperatures fall below 40°F.

1.05 WARRANTY

A. All work on the existing roof shall be done by an approved roofing contractor and in accordance with requirements necessary to maintain Owner's existing warranty. Coordinate with Owner as required.

B. If there is no existing roof warranty in place, then provide a one (1) year warranty for a leak-free, watertight condition.

1.06 PRODUCT HANDLING

A. In accordance with the material manufacturer's instructions.

B. Protect materials from moisture and freezing.

C. Material shall be labeled for ready identification. Labels shall include name of manufacturer, and name and number of the product.

D. Store only the material on the roof surface that can be used in one (1) day.

E. The material stored on the roof surface shall be scattered over the roof deck to avoid damage to the structural roof system. Concentrated loads of high magnitude will not be permitted on the roof. Store felt rolls on end. Store material on wooden pallets or other suitable systems to ensure that the bottoms of rolls are not susceptible to coming in contact with water.

F. Use extreme care in transporting materials across the roof surface. Protect existing and finished roof surfaces. Repairs may have to be made to damaged areas of the existing roof where workmen have damaged areas of the existing roof in transporting materials.

G. Furnish all required storage enclosures and safeguards.

PART 2 – PRODUCTS

2.01 ROOFING MATERIALS

A. Provide roofing materials and insulation to match existing.

PART 3 – EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Verify that surfaces and site conditions are ready to receive work and deck is supported and secured, clean and smooth, flat and dry.

B. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, and cant strips are in place.

3.02 INSTALLATION OF ROOF SYSTEM

A. Install membranes and flashing in accordance with the manufacturer's instructions.

B. All work shall be performed in accordance with the National Roofing Contractor Association - Handbook of Accepted Roofing Knowledge.

3.03 FIELD QUALITY CONTROL

A Examine the structural systems, maximum and minimum parapet heights, maximum and minimum slope, etc., and verify that they are consistent with the requirements of the roof manufacturer. Notify the Architect of any discrepancies prior to Bidding or provide warranty as specified.

3.04 CLEAN UP

A. Remove bituminous markings from finish surfaces. In areas where finished surfaces are soiled by asphalt or any other source of soiling caused by the work of this Section, consult manufacturer of surfaces for cleaning advice and conform to those instructions.

END OF SECTION

SECTION 07 09 00
FIRESTOPPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

A. Fire Containment Insulation and Fire Sealants.

B. Related Sections:
   1. Section 07 21 00 – Thermal Insulation
   2. Section 07 90 00 – Joint Sealers
   3. Division 21 – Fire Suppression
   4. Division 22 - Plumbing
   5. Division 23 - Mechanical
   6. Division 26 - Electrical

1.03 SYSTEM DESCRIPTION

A. Furnish all materials, labor and equipment required to complete firestopping at penetrations through walls and floors as required to preserve the rated integrity of the surface.

1.04 INDUSTRY STANDARDS

A. References: Some products and execution are specified in this Section by reference to published specifications of standards of following with respective abbreviations used:
   1. American Society for Testing and Materials (ASTM)
   2. Underwriters Laboratories (UL)
   3. National Fire Protective Association (NFPA)

1.05 SUBMITTALS

A. Product Data: Provide product data indicating fire performance criteria, limitations, certification that materials meet or exceed specified requirements, and application instructions.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Maintain temperature and humidity recommended by manufacturer during and after installation.

PART 2 – PRODUCTS

2.01 GENERAL

A. Fire-Rated Sealer:
   1. For penetrations with no movement or vibration, and for perimeter sealing: A high-temperature smoke and fire-resistant shield, non-sag, single component sealant, Tremco Fyre Shield.
   2. For penetrations with slight movement or vibration: A one (1) part silicone rubber sealant, Tremco Fyre-Sil.
   3. For penetrations with movement or vibration, with PVC pipe, humid conditions, or where a high degree of intumescence is required: Special purpose acrylic, single component, fire-rated elastomeric sealant, Tremco TremStop 1A.

B. Fire Containment Insulation: USG Thermafiber Safing Insulation or approved substitution.

PART 3 – EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Confirm compatibility of surfaces to receive sealant materials.

B. Verify that surfaces of openings are sound, clean, dry and ready to receive application of sealants.

C. Verify that penetration elements are securely fixed and properly located, with a minimum of 1/2" space between penetrations and surfaces of openings.

D. Protect adjacent surfaces and equipment from damage.

E. Clean contact surfaces of dirt, dust, grease, oil, loose material, or other matter which may affect bond of sealant.

F. Remove incompatible materials which affect bond by scraping, brushing, scrubbing or sandblasting.

3.02 INSTALLATION

A. Apply sealant in strict accordance with manufacturer's instructions.

B. Apply sealant in sufficient thickness to achieve required rating.

3.03 SCHEDULE

A. Walls: Seal gypsum board to floor, deck above, and abutting walls. Seal penetrations at pipe, cable, conduit, cable tray, ducts, expansion joints, etc. though the following walls and partitions, including existing conditions exposed by remodeling work.
   1. Two (2) hour fire-rated partitions.
   2. All smoke partitions.
   3. One (1) hour fire-rated walls.
   4. Walls around mechanical and electrical rooms.

B. Floors: Seal penetrations at pipe, cable, conduit, cable tray, ducts, expansion joints, etc. through all floors covered by the work of this contract, including existing conditions exposed by remodeling work.

END OF SECTION

SECTION 07 21 00
THERMAL INSULATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

A. Sound Attenuation Batts.

B. Related Sections: Section 09 21 16 - Gypsum Board Assemblies

1.03 SUBMITTALS

A. Product Data: Manufacturer's descriptive literature and installation procedures for all materials.

1.04 QUALITY ASSURANCE

A. References: Some products and execution are specified in this Section by reference to published specifications or standards of the following with respective abbreviations used:

1. American Society for Testing and Materials (ASTM)

2. Underwriters Laboratories Inc. (UL)

B. Comply with applicable International Energy Code and local municipality requirements.

1.05 PRODUCT HANDLING

A. Keep insulation always covered and protected from weather and other damaging conditions while in transit and after receipt at the site.

B. Store materials in dry locations. Wet material at any stage of completion is to be removed and replaced with new dry material.

PART 2 PRODUCTS

2.02 SOUND ATTENUATION BATTS

A. Manufacturer: Owens Corning, or approved substitution.

B. Sound Attenuation Batts complying with ASTM C655, Type I and ASTM 136, Flame spread 10, Smoke developed 10 when tested in accordance with ASTM E 84.

C. Size: 2-1/2" or 3-1/2" thick. Thickness and width as required for a tight fit between metal studs.

2.03 ACCESSORIES

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

B. Tape: Bright aluminum, self-adhering type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Prior to the start of work, examine surfaces to receive insulation to ensure that they are in acceptable condition. Starting the work will constitute acceptance of the surfaces as satisfactory.

3.02 INSTALLATION

A. Sound Attenuation Batt Insulation:

1. Install in walls to deck above, where shown on plans.

2. Install it without gaps or voids.

Install friction fit insulation tight to framing members completely filling prepared space.

B. Rigid Insulation:

1. Installation on exterior side of exterior sheathing within air space behind masonry veneer from base of wall up to above room insulation was required to create a completely insulated building envelope.

3.03 CLEAN UP

A. Remove all debris and excess material from the site.

END OF SECTION

SECTION 07 90 00
JOINT SEALERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

A. Preparing sealant substrate surfaces.

B. Placement of joint fillers, backing, and sealants.

C. Related Sections:
   1. Section 07 09 00 – Firestopping
   2. Section 09 21 16 – Gypsum Board Assemblies
   3. Section 09 30 00 – Tiling

1.03 SYSTEM DESCRIPTION

A. System performance to achieve moisture and air-tight joint seals.

1.04 SUBMITTALS

A. Product Data: Provide data indicating sealant chemical characteristics, performance criteria, limitations and color availability.

B. Samples: Submit sealant color samples for color selection.

C. Provide manufacturer's maintenance recommendations for inclusion in Operation and Maintenance Manuals.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and materials installation instructions.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Do not install solvent curing sealants in enclosed building spaces.

B. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.07 WARRANTY

A. The Sealant shall carry a Limited Warranty against defects for a period of two (2) years from date of acceptance. No liability is to be assumed where damage is due to abuse. Repair or replace all sealants and back up material which becomes defective and replace all material consequently damaged, and material removed for repair or replacement at no additional cost to the Owner.

PART 2 PRODUCTS

2.01 SEALANTS

A. Type 1: Siliconized Acrylic Sealant: Single component, water curing, non-staining, non-bleeding, non-sagging; color as selected by Architect; Tremflex 834, manufactured by Tremco, Inc., or approved substitution.

B. Type 2: Polyurethane Sealant: Multi-component, chemical curing, non-staining, non-bleeding, non-sagging type; color as selected by Architect from Fastpac Color System; Dymeric 240, manufactured by Tremco, or approved substitution.

C. Type 3: Polyurethane Sealant: Single-component high performance, low modulus, one-component, moisture curing, polyurethane joint sealer; color as selected by Architect; Dymonic, manufactured by Tremco, Inc., or approved substitution.

D. Type 4: Silicone Sealant: Single component, acetoxy curing, non-sagging, non-staining, fungus resistant, non-bleeding; color as selected by Architect; Tremsil 200, manufactured by Tremco, Inc., or approved substitution.

E. Type 5: Polyurethane Foam Sealant: Single component, expanding foam filler, sealer and insulator, in aerosol dispenser; Urethane Foam Sealant as manufactured by Red Devil, Inc., or approved substitution.

F. Type 6: Polyurethane Paving Joint Sealant: Multi-component, urethane sealant, job mixed, poured-in-place chemically curing, self-leveling; color to match concrete slab; Tremco THC-900 as manufactured by Tremco, or approved substitution.

G. Type 7: Acoustic Sealant: Non-hardening, non-drying, non-bleeding, Tremco Acoustical Sealant, or approved substitution.

H Type 8: High Performance Silicone Sealant: Low modulus, high performance, one-part moisture curing, architectural grade silicone; custom color as selected by Architect; Spectrem 1, as manufactured by Tremco, or approved substitution.

I. Type 9: Fire-Rated Sealer: Refer to Section 07 09 00 - Firestopping.

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: ASTM D1056 (shall be compatible with particular sealant).
   1. Closed cell polyethylene foam rod.
   2. Closed cell butyl rubber foam rod or butyl rubber tube.
   3. Acceptable manufacturers: Dow Chemical Co. and Products Research & Chemical Corp.

D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Verify that surfaces and joint openings are ready to receive work, and that joint measurements and surface conditions are as recommended by the sealant manufacturer.

B. Remove loose materials and foreign matter which may impair adhesion of sealant.

C. Verify that joint backing and release tapes are compatible with sealant.

D. Perform preparation in accordance with ASTM C804 for solvent release sealants.

3.02 INSTALLATION

A. Clean and prime seal joints in accordance with manufacturer's instructions.

B. Install sealant in accordance with manufacturer's instructions.

C. Measure joint dimensions and size materials to achieve required width/depth ratios.

D. Install joint backing to achieve a neck thickness dimension no greater than 1/3 the joint width.

E. Install bond breaker where joint backing is not used.

F. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

G. Tool joints concave.

H. Apply expanding foam polyurethane sealant as recommended by manufacturer.

I. Pavement Joints: Seal all expansion joints and sawed joints in concrete floor slabs with specified sealant. Mix and apply joint filler in strict accordance with the manufacturer's instructions, including joint preparation, primer, etc., as required.

J. Fire-Rated Sealers: Install in strict accordance with manufacturer's instructions.

3.03 SCHEDULE

	LOCATION	TYPE
A.	Interior Door Frame/Wall, joints between dissimilar materials, all other interior joints not specifically detailed as open or feature joint.	Type 1-Siliconized Acrylic, Water Cured Latex
B.	Exterior door frame perimeter, window perimeter, storefront perimeter. gun grade	Type 3-Polyurethane, single-component,
C.	Ceramic Tile/Corners/Door Frame	Type 4-Siliconem fungus resistant
D.	Around electric outlets and switches in exterior walls and furring.	Type 5-Polyurethane, expanding foam
E.	Edges of wallboard at the floor, deck above and intersections with dissimilar materials at all partitions containing sound attenuation blankets.	Type 7-Acoustic sealant
F.	Perimeter sealing and around all penetrations through rated walls and floor	Type 9-Fire-Rated Sealer: Refer to Section 07270 - Firestopping

END OF SECTION

SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:

1. Interior standard steel doors and frames.
2. Exterior standard steel doors and frames.

1.02 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings in accordance with NAAMM- HMMA 803 or ANSI/SDI A250.8.

1.03 COORDINATION

A. Coordinate anchorage installation 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.

B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.04 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

B. Submittal Coordination Meeting:

1. Meeting to include Contractor, Hardware Supplier, Architect, Hardware Consultant, and Owner.
2. Any and all changes at the Submittal Coordination Meeting shall be resubmitted as a revised submittal.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door type.
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 each different wall opening condition.
6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
7. Details of anchorages, joints, field splices, and connections.
8. Details of accessories.
9. Details of moldings, removable stops, and glazing.

C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For door inspector.

1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.
2. Egress Door Inspector: Submit documentation of compliance with NFPA 101, Section 7.2.1.15.4.
3. Submit copy of DHI Fire and Egress Door Assembly Inspector (FDAI) certificate.

B. Product Test Reports: For each type of fire-rated hollow-metal door and frame assembly for tests performed by a qualified testing agency indicating compliance with performance requirements.

C. Field quality control reports.

1.07 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

B. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, section 5.2.3.1 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

C. Egress Door Inspector Qualifications: Inspector for field quality control inspections of egress door assemblies shall meet the qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal doors and frames palletized, packaged, or created to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ceco Door; ASSA ABLOY.
b. Curries Company; ASSA ABLOY.
c. Fleming Door Products Ltd.; ASSA ABLOY.
d. Republic Doors and Frames.
e. Steelcraft; an Allegion brand.

B. Substitutions: Provide in accordance with Section 012500 “Substitution Procedures.”

2.02 INTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B..

1. Doors:

a. Thickness: 1-3/4 inches (44.5 mm).

b. Face: Uncoated steel sheet, minimum thickness of 0.042 inch (1.0 mm).

c. Edge Construction: Model 2, Seamless.

d. Edge Bevel: Provide manufacturer's standard beveled or square edges.

e. Core: Manufacturer's standard.

f. Fire-Rated Core: Manufacturer's standard core for fire-rated and temperature-rise-rated doors.

2. Frames:

a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).

b. Sidelight Frames: Fabricated from same thickness material as adjacent door frame.

c. Construction: Face welded.

3. Exposed Finish: Prime.

2.03 BORROWED LITES

A. Fabricate of uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).

B. Construction: Face welded.

C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.

D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.04 HOLLOW-METAL PANELS

A. Provide hollow-metal panels of same materials, construction, and finish as adjacent door assemblies.

2.05 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.

2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).

3. Post installed Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to the floor.

C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at top of underlayment.

D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

2.06 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

D. Inserts, Bolts, and Fasteners: Hot dip galvanized in accordance with ASTM A153/A153M.

E. 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 hollow- metal frames of type indicated.

F. Glazing: Comply with requirements in Section 088000 "Glazing" and Section 088813 "Fire-Resistant Glazing."

2.07 FABRICATION

A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Side the same 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 welding, or by rigid mechanical anchors.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

C. Hardware Preparation: Factories prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive no templated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with mitered hairline joints.

1. Provide stops and moldings flush with face of door, and with beveled stops unless otherwise indicated.
2. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
3. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
4. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

2.08 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 EXECUTION

3.01 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. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive no templated, mortised, and surface-mounted door hardware.

3.02 INSTALLATION

A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.

B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
    a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
    b. Install frames with removable stops located on secure side of opening.
2. Floor Anchors: Secure with post installed expansion anchors.
    a. Floor anchors may be set with power-actuated fasteners instead of post installed expansion anchors if so indicated and approved on Shop Drawings.
3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
4. In-Place Concrete or Masonry Construction: Secure frames in place with post installed expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
5. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
    a. Squareness: Plus, or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b.
    c. Alignment: Plus, or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
    d. Twist: Plus, or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    e. Plumbness: Plus, or minus 1/16 inch (1.6 mm), measured at jambs at floor.

C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.

1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.

D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.03 FIELD QUALITY CONTROL

A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.

B. Inspections:

1. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.04 REPAIR

A. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Mechanical and electrified door hardware
   2. Electronic access control system components

B. Section excludes:
   1. Windows
   2. Cabinets (casework), including locks in cabinets
   3. Signage
   4. Toilet accessories
   5. Overhead doors

C. Related Sections:
   1. Division 01 Section "Alternates" for alternates affecting this section.
   2. Division 06 Section "Rough Carpentry"
   3. Division 06 Section "Finish Carpentry"
   4. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
   5. Division 08 Sections:
      a. "Metal Doors and Frames"
      b. "Flush Wood Doors"
      c. "Stile and Rail Wood Doors"
      d. "Interior Aluminum Doors and Frames"
      e. "Aluminum-Framed Entrances and Storefronts"
      f. "Stainless Steel Doors and Frames"
      g. "Special Function Doors"
      h. "Entrances"
   6. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
   7. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

1.02 REFERENCES

A. UL LLC
   1. UL 10B - Fire Test of Door Assemblies
   2. UL 10C - Positive Pressure Test of Fire Door Assemblies
   3. UL 1784 - Air Leakage Tests of Door Assemblies
   4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute
   1. Sequence and Format for the Hardware Schedule
   2. Recommended Locations for Builders Hardware
   3. Keying Systems and Nomenclature
   4. Installation Guide for Doors and Hardware

C. NFPA – National Fire Protection Association
   1. NFPA 70 – National Electric Code
   2. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
   3. NFPA 101 – Life Safety Code
   4. NFPA 105 – Smoke and Draft Control Door Assemblies
   5. NFPA 252 – Fire Tests of Door Assemblies

D. ANSI - American National Standards Institute
   1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
   2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
   3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
   4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
   5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.03 SUBMITTALS

A. General:
   1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
   2. Prior to forwarding submittal:
      a. Review drawings and Sections from related trades to verify compatibility with specified hardware.
      b. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:
   1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
   2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
      a. Wiring Diagrams: For power, signal, and control wiring and including:
         1) Details of interface of electrified door hardware and building safety and security systems.
         2) Schematic diagram of systems that interface with electrified door hardware.
         3) Point-to-point wiring.
         4) Risers.
      b. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.
      c. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
   3. Door Hardware Schedule:
      a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
      b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.

c. Indicate complete designations of each item required for each opening, include:

1) Door Index: door number, heading number, and Architect's hardware set number.
2) Quantity, type, style, function, size, and finish of each hardware item.
3) Name and manufacturer of each item.
4) Fastenings and other pertinent information.
5) Location of each hardware set cross-referenced to indications on Drawings.
6) Explanation of all abbreviations, symbols, and codes contained in schedule.
7) Mounting locations for hardware.
8) Door and frame sizes and materials.
9) Degree of door swing and handing.
10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.

4. Key Schedule:

a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.

b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.

c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.

d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.

e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.

f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.

C. Informational Submittals:

1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
2. Provide Product Data:

a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
b. Include warranties for specified door hardware.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:

a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
b. Catalog pages for each product.
c. Final approved hardware schedule edited to reflect conditions as installed.
d. Final keying schedule
e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

E. Inspection and Testing:

1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:

a. Fire door assemblies, in compliance with NFPA 80.
b. Required egress door assemblies, in compliance with NFPA 101.

1.04 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
    a. For door hardware: DHI certified AHC or DHC.
    b. Can provide installation and technical data to Architect and other related subcontractors.
    c. Can inspect and verify components are in working order upon completion of installation.
    d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.
    e. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Certifications:

1. Fire-Rated Door Openings:
    a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
    b. Provide only items of door hardware that are listed products tested by UL LLC, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.
2. Smoke and Draft Control Door Assemblies:
    a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
    b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.
3. Electrified Door Hardware
    a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
4. Accessibility Requirements:
    a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

C. Pre-Installation Meetings

1. Keying Conference

a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:

1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
2) Preliminary key system schematic diagram.
3) Requirements for key control system.
4) Requirements for access control.
5) Address for delivery of keys.

2. Pre-installation Conference

a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

b. Inspect and discuss preparatory work performed by other trades.

c. Inspect and discuss electrical roughing-in for electrified door hardware.

d. Review sequence of operation for each type of electrified door hardware.

e. Review required testing, inspecting, and certifying procedures.

f. Review questions or concerns related to proper installation and adjustment of door hardware.

3. Electrified Hardware Coordination Conference:

a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.

C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.06 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.07 WARRANTY

A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.

1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.

a. Mechanical Warranty

1) Locks

a) Best 9K Series Locks: 10 years

2) Exit Devices

a) Von Duprin: 3 years

3) Closers

a) LCN 4000 Series: 30 years
b) LCN 1460 Series: 30 years

b. Electrical Warranty

1) Locks

a) Best 9K Series Electromechanical Locks: 3 years

2) Exit Devices

a) Von Duprin: 1 year

1.08 MAINTENANCE

A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

B. Turn over unused materials to Owner for maintenance purposes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. The Owner requires use of certain products for their unique characteristics and project suitability to ensure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute."

1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.

B. Approval of manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.

C. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.

D. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

A. Fabrication

1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer's recognized installation standards for application intended.
2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with "Metal Doors and Frames", "Flush Wood Doors", "Stile and Rail Wood Doors" to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.

B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

C. Cable and Connectors:

1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.
2. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.
3. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.03 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

a. Ives 5BB series

2. Acceptable Manufacturers and Products:

a. Hager BB1191/1279 series
b. Stanley FBB series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:

a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high

4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:

a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
b. Interior: Heavy weight, steel, 5 inches (127 mm) high

5. 2 inches or thicker doors:

a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
b. Interior: Heavy weight, steel, 5 inches (127 mm) high

6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
7. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.

8. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:

a. Steel Hinges: Steel pins
b. Non-Ferrous Hinges: Stainless steel pins
c. Out-Swinging Exterior Doors: Non-removable pins
d. Out-Swinging Interior Lockable Doors: Non-removable pins
e. Interior Non-lockable Doors: Non-rising pins

9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

2.04 ELECTRIC POWER TRANSFER

A. Manufacturers:

1. Scheduled Manufacturer and Product:

a. Von Duprin EPT-10

2. Acceptable Manufacturers and Products:

a. Securitron CEPT-10
b. Security Door Controls PTM

B. Requirements:

1. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
2. Locate electric power transfer per manufacturer's template and UL requirements, unless interference with operation of door or other hardware items.

2.05 CYLINDRICAL LOCKS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

a. BEST 9K3 SERIES

2. Acceptable Manufacturers and Products:

a. No Substitute

B. Requirements:

1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3-hour fire doors.
2. Provide locksets with chassis manufactured from zinc alloy and corrosion-treated steel.
3. Provide locks with standard 2-3/4 inches (70 mm) backset with 9/16 inch (14 mm) throw.
4. Provide ASA strikes unless extended lip strikes are necessary to protect trim.
5. Lockset to have anti-rotational studs that are through-bolted.
6. Lever Handles: High-quality zinc alloy with trim components of brass or bronze.

a. Lever Design: 15 D

2.06 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

a. Von Duprin 99/33A series

2. Acceptable Manufacturers and Products:

a. No Substitute

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide grooved touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
7. Provide flush end caps for exit devices.
8. Provide exit devices with manufacturer's approved strikes.
9. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
10. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
11. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
12. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
13. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
14. Provide electrified options as scheduled.
15. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
16. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

2.07 POWER SUPPLIES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

a. Schlage/Von Duprin PS900 Series

2. Acceptable Manufacturers and Products:

a. Securitron BPS series
b. Security Door Controls 600 series

B. Requirements:

1. Provide power supplies approved by manufacturer of supplied electrified hardware.
2. Provide appropriate quantity of power supplies necessary for proper operation of electrified locking components as recommended by manufacturer of electrified locking components with consideration for each electrified component using power supply, location of power supply, and approved wiring diagrams. Locate power supplies as directed by Architect.
3. Provide regulated and filtered 24 VDC power supply, and UL class 2 listed.
4. Provide power supplies with the following features:

a. 12/24 VDC Output, field selectable.
b. Class 2 Rated power limited output.

c. Universal 120-240 VAC input.
d. Low voltage DC, regulated and filtered.
e. Polarized connector for distribution boards.
f. Fused primary input.
g. AC input and DC output monitoring circuit w/LED indicators.
h. Cover mounted AC Input indication.
i. Tested and certified to meet UL294.
j. NEMA 1 enclosure.
k. Hinged cover w/lock down screws.
l. High voltage protective cover.

2.08 CYLINDERS

A. Manufacturers:

1. Scheduled Manufacturer and Product:

a. University of North Texas – Restricted Best Preferred Keyway

2. Acceptable Manufacturers and Products:

a. No Substitute

B. Requirements:

1. Provide cylinders/cores to match Owner’s existing key system, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer’s series as indicated. Refer to “KEYING” article, herein.

2.09 KEYING

A. Scheduled System:

1. Existing factory registered system:

a. Provide cylinders/cores keyed into Owner’s existing factory registered keying system. Comply with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Requirements:

1. Construction Keying:

a. Replaceable Construction Cores.

1) Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.

a) 3 construction control keys
b) 12 construction change (day) keys.

2) Owner or Owner’s Representative will replace temporary construction cores with permanent cores.

2. Permanent Keying:

a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.

1) Master Keying system as directed by the Owner.

b. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.

c. Provide keys with the following features:

1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
2) Patent Protection: Keys and blanks protected by one or more utility patent(s).

d. Identification:

1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
2) Identification stamping provisions must be approved by the Architect and Owner.
3) Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.

e. Quantity: Furnish in the following quantities.

1) Change (Day) Keys: 3 per cylinder/core.
2) Permanent Control Keys: 3.
3) Master Keys: 6.

2.10 KEY CONTROL SYSTEM

A. Manufacturers:

1. Scheduled Manufacturer:

a. Telkee

2. Acceptable Manufacturers:

a. HPC
b. Lund

B. Requirements:

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.

a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
b. Provide hinged-panel type cabinet for wall mounting.

2.11 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

a. LCN 4040XP series

2. Acceptable Manufacturers and Products:

a. No Substitute

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2-inch (38 mm) diameter piston with 5/8-inch (16 mm) diameter double heat-treated pinion journal. QR code with a direct link to maintenance instructions.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.

5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards. Provide snap-on cover clip, with plastic covers, that secures cover to spring tube.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck. Provide graphically labelled instructions on the closer body adjacent to each adjustment valve. Provide positive stop on reg valve that prevents reg screw from being backed out.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.12 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

a. LCN 1460 series

2. Acceptable Manufacturers and Products:

a. No Substitute

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory.
2. Provide door closers with fully hydraulic, full rack and pinion action cast iron cylinder.
3. Closer Body: 1-1/4-inch (32 mm) diameter, with 5/8-inch (16 mm) diameter heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
7. Pressure Relief Valve (PRV) Technology: Not permitted.
8. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.13 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer:

a. Ives

2. Acceptable Manufacturers:

a. Burns
b. Trimco

B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.

2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
3. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.14 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers:

a. Glynn-Johnson

2. Acceptable Manufacturers:

a. Rixson
b. Sargent

B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.
2. Provide friction type at doors without closer and positive type at doors with closer.

2.15 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:

a. Ives

2. Acceptable Manufacturers:

a. Trimco
b. Burns

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
2. Where a wall stop cannot be used, provide overhead stop.
3. Provide roller bumper where doors open into each other and overhead stop cannot be used.

2.16 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer:

a. Zero International

2. Acceptable Manufacturers:

a. National Guard
b. Reese

B. Requirements:

1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

2.17 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer:

a. Ives

2. Acceptable Manufacturers:

a. Burns
b. Trimco

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.18 DOOR POSITION SWITCHES

A. Manufacturers:

1. Scheduled Manufacturer:

a. Schlage

2. Acceptable Manufacturers:

a. GE-Interlogix
b. Sargent

B. Requirements:

1. Provide recessed or surface mounted type door position switches as specified.
2. Coordinate door and frame preparations with door and frame suppliers. If switches are being used with magnetic locking device, provide minimum of 4 inches (102 mm) between switch and magnetic locking device.

2.19 FINISHES

A. FINISH: BHMA 626/652 (US26D); EXCEPT:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Aluminum Geared Continuous Hinges: BHMA 628 (US28)
3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
4. Protection Plates: BHMA 630 (US32D)
5. Overhead Stops and Holders: BHMA 630 (US32D)
6. Door Closers: Powder Coat to Match
7. Wall Stops: BHMA 630 (US32D)
8. Latch Protectors: BHMA 630 (US32D)
9. Weatherstripping: Clear Anodized Aluminum
10. Thresholds: Mill Finish Aluminum

PART 3 - EXECUTION

3.01 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
    1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
    2. Custom Steel Doors and Frames: HMMA 831.
    3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
    4. Installation Guide for Doors and Hardware: DHI TDH-007-20

B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.

C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.

D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.

I. Lock Cylinders:
    1. Install construction cores to secure building and areas during construction period.
    2. Replace construction cores with permanent cores as indicated in keying section.
    3. Furnish permanent cores to Owner for installation.

J. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:
    1. Conduit, junction boxes and wire pulls.
    2. Connections to and from power supplies to electrified hardware.
    3. Connections to fire/smoke alarm system and smoke evacuation system.
    4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
    5. Connections to panel interface modules, controllers, and gateways.
    6. Testing and labeling wires with Architect's opening number.

K. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

L. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.

M. Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

N. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.

O. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

P. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

Q. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

R. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

S. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.03 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.04 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items per manufacturer's instructions to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.05 DOOR HARDWARE SCHEDULE

A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.

C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

D. Hardware Sets:

OPT0388619

HARDWARE GROUP NO. 1.

For use on Door #(s):

H126A

-OMIT STOP FOR THIS MESH GATE.
-GC COORDINATE WITH EXISTING REUSED GATE TO VERIFY NEW HARDWARE WILL FIT AND FUNCTION ON THE EXISTING GATE.
-VERIFY WITH ARCHITECT THAT THE CLASSROOM FUNCTION LOCK AND OMITTING STOP IS ACCEPTABLE.

HARDWARE GROUP NO. 2.

For use on Door #(s):

H134 H137

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 (NRP AS REQ)	652	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	FIRE RATED REMOVABLE MULLION	KR9954 STAB HEIGHT AS REQ	689	VON
1	EA	FIRE EXIT HARDWARE	99-EO-F-499F (EXIT ONLY)	626	VON
1	EA	ELEC FIRE EXIT HARDWARE	RX-QEL-99-L-NL-F-06-CON LENGTH AS REQ	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	MORTISE CYLINDER	1E74 X CAM AS REQ	626	BES
2	EA	SFIC CONST. CORE	C607CCA	622	FAL
2	EA	SFIC PERM CORE	RESTRICTED BEST PREFERRED KEYWAY VERIFY W/OWNER	626	BES
2	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKTS, SPCR & PLATE AS REQ	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488S PSA H & J	BK	ZER
1	SET	MEETING STILE	8193AA (2 PCS - 1 SET)	AA	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	EA	WIRE HARNESS (IN DOOR)	ALLEGION CONNECT TYPE & LENGTH AS REQ		SCH
1	EA	WIRE HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS		SCH
1	EA	CREDENTIAL READER	CREDENTIAL READER VERIFY W/SECURITY CONTRACTOR		
2	EA	DOOR CONTACT	679-05 TYPE AS REQ (COORDINATE W/SECURITY LOCATION OF ALL DOOR CONTACTS)	BLK	SCE
1	EA	POWER SUPPLY	POWER SUPPLY FOR CREDENTIAL READER BY SECURITY CONTRACTOR		
1	EA	POWER SUPPLY	PS902 900-FA 900-2RS 120/240 VAC (OMIT 2RS BOARD WHERE NOT REQ)		VON

-INGRESS BY THE CREDENTIAL READER OR KEY OVERRIDE.
-FREE EGRESS BY THE PUSH PADS.
-WIRE THE ELECTRIFIED LATCH BOLTS TO THE FIRE ALARM SYSTEM.
-THE ELECTRIFIED LATCH BOLT ARE TO REMAIN IN THE EXTENDED POSITION UPON ACTIVATION OF THE FIRE ALARM SYSTEM, UNLESS MANUALLY RETRACTED BY THE PUSH PAD OR BY KEY OVERRIDE.
-COORDINATE POWER SUPPLY WITH SECURITY CONTRACTOR PRIOR TO SUBMITTALS.
-OMIT POWER SUPPLY WHERE PROVIDED BY SECURITY.

HARDWARE GROUP NO. 4.

For use on Door #(s):

H138

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 (NRP AS REQ)	652	IVE
1	EA	CLASSROOM LOCK	9K-3-7-R-15D-S3 X KEYED CONST CORE	626	BES
1	EA	SFIC PERM CORE	RESTRICTED BEST PREFERRED KEYWAY VERIFY W/OWNER	626	BES
1	EA	SURF CLOSER	4040XP SCUSH X MTG BRKTS, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488S H & J (USE SILENCERS @ NON-RATED DOORS) (PERIMETER SEAL BY ALF MFR @ ALF)	BK	ZER

For use on Door #(s):

H146A

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 (NRP AS REQ)	652	IVE
1	EA	OFFICE LOCK	9K-3-7-AB-15D-S3 X KEYED CONST CORE MATCH OWNERS EXISTING KEY SYSTEM	626	BES
1	EA	SFIC PERM CORE	RESTRICTED BEST PREFERRED KEYWAY VERIFY W/OWNER	626	BES
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 6.

For use on Door #(s):

H137A

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 (NRP AS REQ)	652	IVE
2	EA	PUSH PLATE	8200 4" X 16"	630	IVE
2	EA	PULL PLATE	8303 10" 4" X 16" F	630	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKTS, SPCR & PLATE AS REQ	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488S PSA H & J	BK	ZER
1	SET	MEETING STILE	8193AA (2 PCS - 1 SET)	AA	ZER
2	EA	MORT. DOOR BOTTOM	360AA-Z49 (CONCEALED) LENGTH AS REQ	AA	ZER

-SEALS FOR AIR FLOW RESISTANT.

END OF SECTION

SECTION 08 80 00
GLAZING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:

1. Glass for doors, interior borrowed lites, and hollow metal window framing.
2. Glazing sealants and accessories.

1.02 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. IBC: International Building Code.

1.03 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.04 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review temporary protection requirements for glazing during and after installation.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.

C. Glazing Accessory Samples: For sealants and colored spacers, in 12-inch (300-mm) lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.

D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturers of insulating-glass units with sputter-coated, low-E coatings.

B. Product Certificates: For glass.

C. Preconstruction adhesion and compatibility test report.

D. Sample Warranties: For special warranties.

1.07 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 a 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.

1.08 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 instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.09 FIELD 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 are below 40 deg F (4.4 deg C).

1.10 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: 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 for 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

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cardinal Glass Industries.
2. Guardian Industries Corp.; SunGuard.
3. Oldcastle BuildingEnvelope™.
4. Pilkington North America.
5. Vitro (Formerly PPG).

B. Basis-of-Design Manufacturer: Vitro (Formerly PPG).

C. Substitutions: Provide in accordance with Section 012500 “Substitution Procedures.”

D. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.

E. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.02 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: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.

C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.

1. Design Wind Pressures: As indicated on Drawings.
2. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.
3. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

E. 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 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 (Lawrence Berkely National Laboratory) WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
4. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's (Lawrence Berkely National Laboratory) WINDOW 5.2 computer program.
5. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.03 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: "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."

B. Safety Glazing Labeling: Where safety glazing 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.

C. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.

D. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements"

Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.04 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.

B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear).

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

C. Heat-Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear).

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.05 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they 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. 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. Bondaflex Sil 290.

d. Pecora Corporation; 890NST.

e. Sikasil WS-290.

f. Tremco Incorporated; Spectrem 1

2. Substitutions: Provide in accordance with Section 012500 “Substitution Procedures.”

2.06 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating 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.

2.07 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, with 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.

2.08 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.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

B. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

C. 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.

D. Grind smooth and polish exposed glass edges and corners.

PART 3 EXECUTION

3.01 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.

3.02 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 leave visible marks in the completed Work.

3.03 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. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. 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.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

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 (3-mm) 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.

G. 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.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

J. 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.

K. 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.

3.04 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 tape to heads and sills first, then to jambs. Cover horizontal framing joints by applying tape to jambs, 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.

3.05 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 the face of glazing stops.

3.06 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.

3.07 CLEANING AND PROTECTION

A. Immediately after installation remove non-permanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. 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.

1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than four days before the date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.08 MONOLITHIC GLASS SCHEDULE

A. Clear annealed float glass.
   1. Minimum Thickness: 6 mm.

B. Clear fully tempered float glass.
   1. Minimum Thickness: 6 mm.
   2. Safety glazing required.

END OF SECTION

SECTION 09 21 16
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

A. Metal stud wall framing. metal channel ceiling framing, exterior sheathing, gypsum board with taped and sanded joint treatment and texture surfacing.

B. Related Sections:
   1. Section 06 10 00 - Rough Carpentry
   2. Section 07 21 00 - Thermal Insulation
   3. Section 07 09 00 - Firestopping
   4. Section 07 90 00 - Joint Sealers
   5. Section 09 90 00 - Painting and Coating

1.03 SUBMITTALS

A. Manufacturer's Data for each product.

B. Texture Samples: Maximum of four (4) different textures on 12" x 12" gypsum board for selection by Architect.

C. Submit layout of gypsum board wall control joints for Architect's approval.

1.04 QUALITY ASSURANCE

A. Perform work in accordance with GA 216-2007 Application and Finishing of Gypsum Panel Products.

1.05 PRODUCT HANDLING

A. Keep material dry, protected from weather and direct sunlight exposure.

B. Stack flat and prevent sagging or damage to ends, edges and surfaces.

C. Fully identify manufacturer's name, brand, type and grade.

PART 2 PRODUCTS

2.01 GYPSUM BOARD SYSTEM

A. Manufacturers:
   1. National Gypsum Co., Type Fireshield
   2. United State Gypsum Co., Type Fire code
   3. Georgia Pacific Corp., Type Firestop

B. Interior Wall Studs: 6" C-shaped with serrated faces. Gauge to be per SSMA (Steel Stud Manufacturers Association), Limiting Wall Height Table – Non-Composite, conforming to 5 psf, L/240 for appropriate lengths. Sizes as indicated on the drawings.

C. Interior Wall Track
   1. 20-Gauge (min. uncoated thickness, 0.0312")
   2. Bottom Track to be minimum 1-1/4" leg unless noted otherwise
   3. Bottom Track to be 4" leg at Corridors.
   4. Slotted Top Track: Sliptrack System, SLP-TRK, 16-Gauge, 2 ½" down-standing legs with ¼" wide by 1 ½" high slots spaced at 1" on centers.

D. Shaft Wall Studs and Tracks: GA 216, galvanized sheet steel.
   1. 20-Gauge.
   2. Size: 2-1/2" inside x 1-1/2" wide.

E. Gypsum Board Types:

1. Standard: 5/8" thick, maximum permissible length; ends square cut, tapered edges, unless noted otherwise in this Section. Standard Type: ANSI/ASTM C36.
2. Moisture Resistant Type: 5/8" thick, ANSI/ASTM C630.

F. Fasteners: GA201 and GA216.

2.03 METAL TRIM

A. Fabricate from galvanized steel, not lighter than 0.0217" nominal thickness.

B. Corner Beads: Metal Wallboard Corner Bead 1-1/8" x 1-1/8", ASTM C1047, or approved substitution.

C. Edge Trim: No. 200 Wallboard Casing, or approved substitution.

D. Control Joints: E-Z Strip Expansion Joint, ASTM C1047, or approved substitution.

2.04 ACCESSORIES

A. Joint Materials: GA 216, reinforcing tape, joint compound, adhesive, and water.

B. Sealant: Non-hardening, non-shrinking, for use in conjunction with gypsum board in accordance with Section 07900.

C. Bracing, Furring, Bridging, Plates, Gussets, Clips: Formed steel, thickness determined for conditions encountered; same finish as framing members.

D. Screws: ASTM A90, hot dip galvanized, self-drilling, self-tapping.

E. Anchorage Devices: Power actuated.

F. Welding: In accordance with AWS D1.1 and AWS D1.3.

2.05 FINISHES

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: Where indicated on Drawings.
3. Level 3: Where indicated on Drawings.
4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
   a. Primer and its application to surfaces are specified in Section 099123 "Interior painting."
5. Level 5: Where indicated on Drawings.
   a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

PART 3 EXECUTION

3.01 INSTALLATION - METAL STUDS

A. Partition Heights:
1. Full Height: Partitions shall extend to deck above at all rated walls, walls scheduled for sound attenuation batts, corridors, party walls between apartments, and walls for rooms with no ceiling (open to deck above), and elsewhere as indicated on the Drawings.

B. Install studs in accordance with GA 216.

C. Space metal studs at 16" o.c.

D. Align floor and ceiling tracks; locate to wall layout. Secure in place with fasteners at maximum 16" o.c. Coordinate installation of sealant with floor and ceiling tracks.

E. Slotted Top Track: Install slotted tracks in strict accordance with Manufactures instructions
   1. Secure studs to slotted top track with #8 wafer-head screws.
   2. Maintain minimum deflection gap of 0.65 inch between top of stud and top of slotted track.
   3. Limit vertical movement to 1", plus or minus ½".

F. Space studs not more than 2" from abutting walls and at each side of openings. Connect studs to tracks using fastener or welding method on both side at top and bottom.

G. Construct corners using a minimum of three (3) studs. Double stud wall openings, door and window jambs.

H. Erect load bearing studs one (1) piece full length. Splicing of studs is not permitted.

I. Allow for deflection, directly below horizontal building framing for non-load bearing framing.

J. Attach cross studs to studs for attachment of fixtures anchored to walls and for attachment of mechanical and electrical items within walls.

3.03 INSTALLATION - CEILING

A. Install in accordance with GA 216.

B. Coordinate location of hangers with other work. Install ceiling framing independent of walls, columns, and above ceiling work.

C. Reinforce openings in ceiling suspension system which interrupt main carrying channels or furring channels, with lateral channel bracing.

D. Laterally brace the entire suspension system.

3.04 INSTALLATION - GYPSUM BOARD

A. Install gypsum board in accordance with GA-216 and GA-600 and manufacturer's instructions.

B. Fasten gypsum board to furring or framing with nails or screws. Staples may only be used when securing the first layer of double layer applications.

C. Place control joints not to exceed 30'-0" o.c., consistent with lines of building spaces as directed by Architect if slab on grade, then vertical control joint shall be placed from top corners of doors and windows to above ceiling, and from bottom corners of windows to floor.

D. Place corner beads at external corners. Use the longest practical length. Place edge trim where gypsum board abuts dissimilar materials.

E. Seal cut edges and holes in moisture-resistant gypsum board with sealant.

F. Hold bottom of gypsum panels exactly 3/8" above concrete floor. This will provide the wall base material the best substrate without the gypsum panels touching the concrete floor and allowing potential wicking from water that might get on the floor.

G. Place corner beads at external corners. Use the longest practical length. Place edge trim where gypsum board abuts dissimilar materials.

H. Use moisture-resistant gypsum board as back-up where ceramic tile or glazed paint is shown or scheduled on the Drawings.

I. Finish horizontal and vertical surfaces of fire-rated gypsum board enclosures as required to meet fire rating.

3.06 JOINT TREATMENT

A. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.

B. Feather coats onto adjoining surfaces so that camber is maximum 1/32".

C. Filling and sanding only is required at surfaces behind adhesive applied ceramic tile.

D. Prepare the bottom of walls to provide smooth flat surface at juncture with floor to receive base.

3.07 TEXTURE SURFACING

A. All exposed gypsum board surfaces to receive texture.

END OF SECTION

SECTION 09 22 16
NON-STRUCTURAL METAL FRAMING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Non-load-bearing steel framing systems for interior partitions.
   2. Suspension systems for interior ceilings and soffits.
   3. Grid suspension systems for gypsum board ceilings.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Span and Deflection Design Criteria: Provide height to load deflection charts showing studs supplied conform to deflection limit scheduled and allowed per ASTM C 754.
   1. Mark on chart(s) showing all major partitions scheduled conformance with criteria.
   2. Submit manufacturer's certification of stud size, thickness, and spacing complying with performance requirements and selections made by architect are correct for application shown.

1.03 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of code-compliance certification for studs and tracks.

B. Evaluation Reports: For firestop tracks, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.04 QUALITY ASSURANCE

A. 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.
   1. Provide materials in accordance with Steel Stud Manufacturers Association (SSMA) chart for recommendation related to this project spans and loading conditions.
   2. For interior studs provide C-Shaped with serrated faces. Gauge to be per SSMA, limiting wall height table-non-composite. Sizes as indicated on drawings.

1.05 SEQUENCING

A. Coordinate placement of concealed internal wall reinforcement, such as backing plates, for items to be attached to metal support systems.

B. Coordinate installation of ceiling and soffit suspension systems with installation of overhead structural assemblies to ensure that inserts and other provisions for anchorage to building structure have been installed to receive ceiling hangers that will develop their full strength and at spacing required to support ceilings.

C. Furnish concrete inserts, and other devices indicated, to other trades for installation well in advance of time needed for coordination with other construction.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202 "Code of Standard Practice."

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Design framing systems in accordance with AISI S220, "North American Specification for the Design of Cold-Formed Steel Framing - Nonstructural Members" and ASTM C645, Section 10, unless otherwise indicated.

B. 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.

C. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

D. Horizontal Deflection:
   1. Minimum Base-Metal Thickness: 25 gage unless indicated otherwise on Drawings or below.
   2. 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.
   3. Interior Metal Stud/Gypsum Board Assemblies at Lobbies, Service Corridors, Exit Corridors, and Vertical Shafts: Withstand lateral loading (air pressure) of 7.5 psf with deflection limit not more than L/360 of partition height.
   4. 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 22 gage studs at 16 inches on center.
   5. Where wall mounted equipment, woodwork, and casework items are indicated or elsewhere as shown on Drawings, provide minimum 16 gage studs.
   6. Where bumper or guard rails are indicated, provide minimum 0.033 inches (22-gage) thick studs.
   7. Where cementitious backer units are indicated, provide minimum 0.033-inch (22-gage) thick studs.
   8. At jambs of openings provide two minimum 20 gage studs.
   9. Ceilings: At ceilings using mold-mildew resistant gypsum framing to be 16 inches o.c. for 5/8 inch gypsum.

2.02 FRAMING SYSTEMS

A. Framing Members, General: Comply with AISI S220 and ASTM C645 for conditions indicated.
   1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
   2. Protective Coating: Comply with AISI S220 and ASTM A 653/A 653M, G40 (Z120) or coating with equivalent corrosion resistance of ASTM A653/A653M, G40 (Z120), hot-dip galvanized unless otherwise indicated. ,
      a. Coating roll-formed from steel complying with mechanical and chemical requirements of ASTM A1003 with a zinc-based coating.
      b. Coatings shall demonstrate equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction

B. Studs and Tracks: AISI S220 and ASTM C 645, Section 10
   1. Steel Studs and Tracks:
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) CEMCO.
         2) ClarkDietrich
         3) MarinoWARE.
         4) MBA Building Supplies.
         5) SCAFCO Steel Stud Company.
         6) Steel Network, Inc. (The).
      b. Minimum Base-Metal Thickness: As required by performance requirements for horizontal deflection.

c. Depth: As indicated on Drawings.

2. Substitutions: Provide in accordance with Section 01 25 00 “Substitution Procedures.”

C. Slip-Type Head Joints: Where studs are continuous from floor to structure above, provide the following:

1. Deflection Track: Steel sheet top track 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Blazeframe Industries.
      2) CEMCO; California Expanded Metal Products Co.
      3) ClarkDietrich Building Systems.
      4) MarinoWARE.
      5) SCAFCO Steel Stud Company.
      6) Steel Network, Inc. (The).
2. Substitutions: Provide in accordance with Section 01 25 00 “Substitution Procedures.”

D. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Blazeframe Industries.
   b. CEMCO; California Expanded Metal Products Co.
   c. ClarkDietrich Building Systems.
   d. Fire Trak Corp.
   e. MarinoWARE.
   f. SCAFCO Steel Stud Company.
   g. Steel Network, Inc. (The).
2. Substitutions: Provide in accordance with Section 01 25 00 “Substitution Procedures.”

E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ClarkDietrich Building Systems.
   b. MarinoWARE.
   c. MRI Steel Framing, LLC.
   d. SCAFCO Steel Stud Company.
2. Minimum Base-Metal Thickness: 0.0179 inch (0.455 mm).
3. Substitutions: Provide in accordance with Section 01 25 00 “Substitution Procedures.”

F. Cold-Rolled Channel Bridging: Steel, 0.0538-inch (1.367-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ClarkDietrich Building Systems.
   b. MarinoWARE.
   c. MRI Steel Framing, LLC.
   d. SCAFCO Steel Stud Company
2. Depth: As indicated on Drawings.
3. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.

4. Substitutions: Provide in accordance with Section 01 25 00 “Substitution Procedures.”

G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ClarkDietrich Building Systems.
      b. MarinoWARE.
      c. MRI Steel Framing, LLC.
      d. SCAFCO Steel Stud Company
   2. Minimum Base-Metal Thickness: 0.0179 inch (0.455 mm).
   3. Depth: 7/8 inch (22.2 mm).
   4. Substitutions: Provide in accordance with Section 01 25 00 “Substitution Procedures.”

H. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ClarkDietrich Building Systems.
      b. MarinoWARE.
      c. MRI Steel Framing, LLC.
      d. SCAFCO Steel Stud Company
   2. Configuration: Asymmetrical.
   3. Substitutions: Provide in accordance with Section 01 25 00 “Substitution Procedures.”

I. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
   1. Depth: 3/4 inch (19 mm).
   2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch (0.8 mm).
   3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire

J. Partial Wall Framing Connection: Connector designed to support out-of-plane loading of cantilevered partial wall systems that are unsupported at the top track.
   1. ClarkDietrich; Pony Wall or comparable product.
   2. Minimum Base-Steel Thickness: 0.0966 inch (2.45 mm).

K. Flat Hangers: Steel sheet, 1 by 3/16 inch (25 by 5 mm) by length indicated.

L. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch (1.367 mm) and minimum 1/2-inch- (13-mm-) wide flanges.
   1. Depth: As indicated on Drawings.

M. Furring Channels (Furring Members):
   1. Cold-Rolled Channels: 0.0538-inch (1.367-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
   2. Steel Studs and Tracks: AISI S220 and ASTM C 645.
      a. Minimum Base-Metal Thickness: 0.0179 inch (0.455 mm).
      b. Depth: 1-5/8 inches (41 mm).
   3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22 mm) deep.
      a. Minimum Base-Metal Thickness: 0.0179 inch (0.455 mm).
   4. Resilient Furring Channels: 1/2-inch- (13-mm-) deep members designed to reduce sound transmission.
      a. Configuration: Asymmetrical.

2.03 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.
   1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. 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 (3.2 mm) thick, in width to suit steel stud size.

PART 3 EXECUTION

3.01 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.

3.02 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.

3.03 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 framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.04 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: As required by horizontal deflection performance requirements unless otherwise indicated.
   2. Multilayer Application: As required by horizontal deflection performance requirements unless otherwise indicated.
   3. Tile Backing Panels: As required by horizontal deflection performance requirements 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 on the floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings. Continue framing around ducts that penetrate 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 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 (13-mm) 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.
   6. Curved Partitions:
      a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
      b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches (150 mm) o.c.

E. Direct Furring:
   1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder- driven fasteners spaced 24 inches (610 mm) o.c.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.05 INSTALLING CEILING 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 (1219 mm) o.c.
   2. Carrying Channels (Main Runners): 48 inches (1219 mm) o.c.
   3. Furring Channels (Furring Members): 16 inches (406 mm) 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, counter splaying, 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 (3 mm in

G. m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION

SECTION 09 51 15
ACOUSTICAL PANEL CEILINGS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

A. Suspended metal grid ceiling system, acoustical tile and Mylar-faced tile.

1.03 SYSTEM DESCRIPTION

A. Install system capable of supporting imposed loads to a deflection of 1/270.

B. Conform to applicable code for combustibility requirements for materials.

C. Ceiling / Floor Fire-Rated: Listed Assembly by U.L. No. D916.

D. Ceiling / Roof Fire-Rated Assembly: Listed Assembly by U.L., No. P259, 1-Hour.

1.04 SUBMITTALS

A. Product Data: Provide material specifications, characteristics, and instructions for installation.

B. Samples:
   1. Two (2) 6" x 6" samples of each type of ceiling panel.
   2. One (1) 1'-0" long sample of suspension system, including main runner, cross tees, and wall molding.

C. Provide manufacturer's maintenance recommendations for inclusion in Operations and Maintenance Manual.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Maintain condition ranges of 60°F to 85°F at not more than 70% relative humidity. These conditions shall be maintained prior to, during, and after installation. Areas shall be free of construction dust and debris.

B. Product to be at room temperature prior to installation.

1.06 EXTRA MATERIAL

A. Provide 48 sq. ft. (12 tiles) extra 24" x 24" acoustical tiles in clearly marked boxes.

B. Deliver extra material to Owner storage as directed by Owner.

PART 2 PRODUCTS

2.01 SUSPENSION SYSTEM

A. Manufacturers:
   1. Armstrong World Industries, Inc.
   2. Donn Products, Inc.
   3. National Rolling Mills, Co.

B. Grid: Prelude Fire Guard Exposed T configuration, 1-1/2" tall with 15/16" wide bottom flange, conforming to ASTM C635, intermediate duty, non-fire-rated; components die cut and interlocking, double web steel construction. Cross tees shall be removable without special tools and shall be reusable.

C. Accessories:
   1. Hanger wire, clips and splices required for suspended grid system.
   2. Wall Channel Molding: “L” shape 7/8" wide x 7/8" high.

D. Grid Materials: Commercial quality coiled rolled steel with galvanized coating, minimum 0.019" thick nominal.

E. Finishes:
   1. Electro-galvanized and protective-conversion-coated.
   2. Baked polyester finish on all exposed surfaces. Color to be white.

F. Support Channels and Hangers: 12-Gauge annealed or galvanized wire.

2.02 ACOUSTIC UNITS

A. Manufacturers: Armstrong World Industries, Inc. or approved substitution.

B. Acoustic Ceiling Tile: Square edge, non-rated, Minaboard Fissured. Conforming to the following:
   1. Size: 24" x 24".
   2. Thickness: 3/4".
   3. Surface Finish: White.

2.04 ACCESSORIES

A. Touch-Up Paint: As recommended by component manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Verify that layout of grid and hangers will not interfere with other work.

3.02 EXISTING CEILINGS

A. In rooms where Work will be performed, mark damaged ceilings and ceiling tiles with easily removable, red "stick-on" labels, minimum 2 sq. in.

B. Do not begin work until damaged ceiling list has been reviewed by Architect and Owner. Damaged ceilings on approved list to remain as existing with no repair required. Damaged ceilings and ceiling tiles in rooms where Work is performed that are not on approved list shall be repaired and replaced.

C. Fire ratings must be maintained at existing ceilings. Where work involves any replacement of ceilings, provide products for assemblies as required to conform to UL P207, 1 hour for work in existing building *and UL P214, 1 hour at Teaching Areas 145 and 146*.

3.03 INSTALLATION - SUSPENSION SYSTEM

A. Install system in accordance with ASTM C636.

B. Coordinate the location of hangers with other work. Where components prevent the regular spacing of hangers, reinforce the system to span the extra distance.

C. Hang system independent of walls, columns, ducts, pipes and conduit.

D. Locate system on room axis according to the Drawings.

E. Install edge molding at intersection of ceiling and vertical surfaces, using longest practical lengths.

3.04 INSTALLATION - ACOUSTIC CEILIING TILES

A. Install acoustic units level, free from damage, twist, warp or dents.

B. Field Cutting:
   1. Where panels abut vertical surfaces and where shown on the Drawings, field cut panels as required with sharp fresh blade to snugly fit into grid. Field cut edges to match reveal shape at factory cut edge.
   2. At field cut panels that are not adjacent to walls and field cut panels that abut walls forming an outside corner or at locations as needed to create a smooth even appearance, field paint cut edge with touch up paint as required to match factory panel finish.

END OF SECTION

SECTION 09 61 00
RESINOUS FLOORING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes one resinous flooring system, one with urethane body.
   1. Application Method: Squeegee, screed, and broadcast.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.

B. Samples for Verification: For each resinous flooring system required, 5 inches (150 mm) square, applied to a rigid backing.

C. Product Schedule: Use resinous flooring designations indicated in Part 2 and room designations indicated on Drawings in product schedule.

D. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

E. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.04 QUALITY ASSURANCE

A. No request for substitutions will be allowed. Further modifications of this spec would be at the discretion of Stonhard and the Architect of Record.

B. Installer Qualifications: Engage an experienced installer (applicator) who is experienced in applying resinous flooring systems similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance, and who is acceptable to resinous flooring manufacturer.
   1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.
   2. Contractor shall have completed at least 10 projects of similar size and complexity.

C. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, through one source from a single manufacturer, with not less than ten years of successful experience in manufacturing and installing principal materials described in this section. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.

D. Manufacturer Field Technical Service Representatives: Resinous flooring manufacture shall retain the services of Field Technical Service Representatives who are trained specifically on installing the system to be used on the project.

   1. Field Technical Services Representatives shall be employed by the system manufacture to assist in the quality assurance and quality control process of the installation and shall be available to perform field problem solving issues with the installer.

E. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Apply full-thickness mockups on 48-inch- (1200-mm-) square floor area selected by Architect.
      a. Include 48-inch (1200-mm) length of integral cove base.
   2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

F. Pre-installation Conference:
   1. General contractor shall arrange a meeting not less than thirty days prior to starting work.
   2. Attendance:
      a. General Contractor
      b. Architect/Owner's Representative.
      c. Manufacturer/Installer's Representative.

1.05 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 mixing with other components.

B. Store materials to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects. Store materials per product data sheet.

C. All materials used shall be factory pre-weighed and pre-packaged in single, easy to manage batches to eliminate on site mixing errors. No on site weighing or volumetric measurements allowed.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
   1. Maintain material and substrate temperature between 65 and 85 deg F (18 and 30 deg C) during resinous flooring application and for not less than 24 hours after application.

B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application, unless manufacturer recommends a longer period.

D. Concrete substrate shall be properly cured. A vapor barrier must be present for concrete subfloors on or below grade. Otherwise, an osmotic pressure resistant grout must be installed prior to the resinous flooring

1.07 WARRANTY

A. Manufacturer shall furnish a single, written warranty covering both material and workmanship for a period of (1) full years from date of installation or provide a joint and several warranty signed on a single document by material manufacturer and applicator jointly and severally warranting the materials and workmanship for a period of (1) full year from date of installation. A sample warranty letter must be included with bid package or bid may be disqualified.

PART 2 - PRODUCTS

2.01 RESINOUS FLOORING

A. Available Products: Subject to compliance with requirements.

B. Confirm inclusion of 25mil body coat, and broadcast quartz into primer increasing bond strength. Products that may be incorporated into the work include,

C. Products: Subject to compliance with requirements:
   1. Stonhard, Inc.; Stontec UTF®. Basis of Design.

D. System Characteristics:
   1. Color and Pattern: Select from manufactures standards
   2. Wearing Surface: Standard
   3. Integral Cove Base: TBD
   4. Overall System Thickness: 2mm

E. System Components: Manufacturer's standard components that are compatible with each other and as follows:
   1. Primer:

a. Material Basis: Stonhard UTF Primer
b. Resin: Urethane
c. Formulation Description: (2) two component, low viscosity, urethane.
d. Application Method: Squeegee and nap roller.
e. Number of Coats: (1) one.
f. Aggregates: Broadcast quartz into wet primer coat.

2. Body Coat(s):
   a. Material Basis: Stontec UTF Undercoat.
   b. Resin: Polyaspartic Urethane
   c. Formulation Description: (3) three component polyaspartic urethane resin, aliphatic isocyanate and filler.
   d. Application Method: Squeegee and medium nap roller.
      1) Thickness of Coats: 25-30 mils with standard primer coat
      2) Number of Coats: (1) One.
3. Broadcast:
   a. Material Basis: Stontec Flakes
   b. Formulation Description: Decorative flake (1/16" or ¼)
   c. Type: Tweed (chips to be mixed in Mfg. facility)
   d. Finish: Broadcast to rejection.
   e. Number of Coats: one.
4. Topcoat:
   a. Material Basis: CF7
   b. Resin: Urethane
   c. Formulation Description: (2) two component, UV resistant, aliphatic polyaspartic urethane
   d. Type: Clear.
   e. Finish: Flat.
   f. Number of Coats: (2) two.
5. Topcoat: (Sealed Concrete Areas)
   a. Material Basis: HT4
   b. Resin: Epoxy
   c. Formulation Description: (2) two-component, 100% solids, epoxy coating.
   d. Type: Pewter
   e. Finish: Flat
   f. Coats: (1) One
6. Groutcoat: (Infill of Trench Drains)
   a. Material Basis: Stonset TG6
   b. Resin: Urethane
   c. Formulation Description: a four-component, fast-setting, trowelable grout.
   d. Type: White
   e. Number of coats: (1) one

Note: Components listed above are the basis of design intent; all bids will be compared to this standard including resin chemistry, color, wearing surface, thickness, and installation procedures, including number of coats. Contractor shall be required to comply with all the requirements of the Specifications and all of the components required by the Specifications, whether or not such products are specifically listed above.

F. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:
   1. Tensile Strength: 2,200 psi per ASTM D-638
   2. Flexural Strength: 2,000 psi per ASTM D-790
   3. Flexural Modulus of Elasticity: 2.6 x 10^6 psi per ASTM D-790
   4. Hardness: .60 per ASTM D-2240, Shore D
   5. Indentation: no indentation per MIL-D-3134F
   6. Linear Coefficient of Thermal Expansion: 23 x 10^-6 in./in.°F per ASTM C-531
   7. Impact Resistance: Exceeds 160 in.-lbs. per ASTM D-4060, CS-17

8. Flammability: Class I per ASTM E-648

2.02 ACCESSORY MATERIALS

A. Patching, Leveling and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated. No Single component or cementitious materials.

B. Joint Sealant: Type recommended or produced by resinous flooring manufacturer for type of service and joint condition indicated.

PART 3 - EXECUTION

3.01 PREPARATION

A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean and dry substrate for resinous flooring application.

B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
   1. Mechanically prepare substrates as follows:
      a. Mechanically prepare with the use of Diamond grinding equipment to provide surface sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring. Or,
      b. 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 or Diamond Grind with a dust free system.
   2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written recommendations.
   3. Verify that concrete substrates meet the following requirements.
      a. Perform in situ probe test, ASTM F 2170. Proceed with application only after substrates do not exceed a maximum potential equilibrium relative humidity of 80 percent.
      b. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. of slab in 24 hours.
      c. Perform additional moisture tests recommended by manufacturer. Proceed with application only after substrates pass testing.

C. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

D. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written recommendations. Allowances should be included for Stonflex MP7 joint fill material.

3.02 APPLICATION

A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
   1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
   2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
   3. At substrate expansion and isolation joints, provide joint in resinous flooring to comply with resinous flooring manufacturer's written recommendations.
      a. Apply joint sealant to comply with manufacturer's written recommendations.

B. Mix and apply primer over properly prepared substrate with strict adherence to manufacturer's installation procedures and coverage rates

C. Broadcast: Immediately broadcast quartz silica aggregate into the primer using manufacturer's specially designed spray caster. Strict adherence to manufacturer's installation procedures and coverage rates is imperative.

D. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, and top coating of cove base. Round internal and external corners. Refer to detail drawings.

E. Body coat: Mix base material according to manufacturer's recommended procedures. Uniformly spread mixed material over previously primed substrate using manufacturer's installation tool. Roll material with strict adherence to manufacturer's installation procedures and coverage rates.

F. Broadcast: Immediately broadcast decorative flakes into the body coat. Strict adherence to manufacturer's installation procedures and coverage rates is imperative.

G. First Sealer: Remove excess un-bonded flakes by lightly brushing and vacuuming the floor surface. Mix and apply sealer with strict adherence to manufacturer's installation procedures.

H. Second sealer: Lightly sand first sealer coat. Mix and apply second sealer coat with strict adherence to manufacturer's installation procedures.

3.03 TERMINATIONS

A. Chase edges to “lock” the coating system into the concrete substrate along lines of termination.

B. Penetration Treatment: Lap and seal coating onto the perimeter of the penetrating item by bridging over compatible elastomer at the interface to compensate for possible movement.

C. Trenches: Continue coating system into trenches to maintain monolithic protection. Treat cold joints to assure bridging of potential cracks.

D. Treat floor drains by chasing the coating to lock in place at point of termination.

3.04 JOINTS AND CRACKS

A. Treat control joints to bridge potential cracks and to maintain monolithic protection.

B. Treat cold joints and construction joints and to maintain monolithic protection on horizontal and vertical surfaces as well as horizontal and vertical interfaces.

C. Vertical and horizontal contraction and expansion joints are treated by installing backer rod and compatible sealant after coating installation is completed. Provide sealant type recommended by manufacturer for traffic conditions and chemical exposures to be encountered.

3.05 FIELD QUALITY CONTROL

A. Material Sampling: Owner may at any time and any numbers of times during resinous flooring application require material samples for testing for compliance with requirements.
   1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
   2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
   3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

3.06 CLEANING, PROTECTING, AND CURING

A. Cure resinous flooring materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of application and prior to completion of curing process. Close area of application for a minimum of 24 hours.

B. Protect resinous flooring materials from damage and wear during construction operation. Where temporary covering is required for this purpose, comply with manufacturer's

recommendations for protective materials and method of application. General Contractor is responsible for protection.

C. Cleaning: Remove temporary covering and clean resinous flooring just prior to final inspection. Use cleaning materials and procedures recommended by resinous flooring manufacturer. General Contractor responsible for cleaning prior to inspection.

END OF SECTION

SECTION 09 61 16
CONCRETE FLOOR SEALING

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes:
   1. Sealing of concrete floor areas not otherwise scheduled to receive finish floor covering.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
   1. Include data to indicate chemical, solvent, and detergent resistance.
   2. Include information for primer, sealants, accessories and other required components.

1.03 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fluid-applied floor sealer to include in maintenance manuals. Include the following:
   1. Manufacturer's instructions on maintenance renewal of applied treatments.
   2. Protocols and product specifications for joint filing, crack repair and/or surface repair.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing Products specified in this Section with minimum 10 years documented experience.

B. Installer Qualifications: An installer (applicator) who is approved, trained, or certified by a fluid-applied floor sealer manufacturer.

C. Source Limitations: Furnish products from one manufacturer for entire Project, unless otherwise acceptable to Architect.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in a manner to prevent damage to containers and bags.

B. Store materials in accordance with manufacturer's instructions in clean and dry location with temperature between 60 deg F and 90 deg F.

C. Keep products away from fire or open flame.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Comply with flooring manufacturer's written instructions for substrate temperature, ambient temperature, humidity, ventilation, and other conditions affecting flooring application.
   1. Do not apply flooring until spaces are enclosed and weatherproof; wet work in spaces is complete and dry; and overhead work, including installing mechanical systems, lighting, and athletic equipment, is complete.

B. Conditioning Period: Begins not less than 7 days before flooring application, is continuous through application, and continues not less than 3 days after application.
   1. After conditioning period, maintain relative humidity and ambient temperature planned for building occupants.

C. Ventilate area where flooring is being installed. Post and enforce no smoking and no open flame signs until flooring has cured.

D. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during floor sealer application.

E. Close spaces to traffic during floor sealer application and for not less than 24 hours after application unless manufacturer recommends a longer period.

1.07 WARRANTY

A. Provide a written warranty signed by the manufacturer warranting work to be free from defective materials and workmanship and agreeing to replace components which fail within 2 years from the date of Substantial Completion.
   1. Failed materials and workmanship include spalling, cracking, and delamination.

PART 2 PRODUCTS

2.01 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. Dayton Superior Specialty Chemical Corp.
   2. L & M Construction Chemicals, Inc.
   3. Euclid Chemical.
   4. The Sherwin-Williams Company.

2.02 CONCRETE FLOOR SEALER

A. Epoxy Floor Coating: Two component, water-based, high-performance, high-solids, epoxy floor coating system.
   1. Basis-of-Design Products:
      a. The Sherwin-Williams Company; Concrete & Terrazzo Waterproofing Sealer, B44V22.
      b. Euclid; Euco 512 VOX Epoxy Sealer.
   2. Use sealers that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Substitutions: Provide in accordance with Section 012500 “Substitution Procedures.”

2.03 ACCESSORIES

A. Joint Sealant Materials: Manufacturer's recommended sealant compatible with flooring system for type of service and joint condition indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, with Installer present, for conditions affecting performance of flooring including substrate moisture content.

B. Examine areas to receive flooring for:
   1. Defects in substrate that may affect proper execution of flooring work.
   2. Deviations beyond allowable tolerance for concrete slab work.
   3. Surface curing agents or sealers that would inhibit bond.
   4. Surface defects such as cracks that could transfer through to finished flooring surface if not corrected.

C. Do not begin flooring work until concrete has cured a minimum of 28 days.

D. Do not begin work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Prepare Substrate: Tests concrete substrate for pH, contaminants, and moisture content in accordance with manufacturer's recommendations. Ensure concrete is within manufacturers recommended limits prior to installation.

B. Concrete Sub-floors: Verify that concrete slabs comply with ASTM D 4258 and the following:
   1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond.

2. Mechanically abrade or shot-blast concrete flooring to remove inappropriate curing agents and to open pores of concrete surfaces to allow penetration of bonding agent. Completely remove cleaning residue. Acid washing is not acceptable.
3. Repair cracks, divots and surface imperfections according to manufacturer's instructions.
4. Vacuum to remove dust and debris.

C. Protect walls, floor openings, equipment, electrical openings, door frames, and other obstructions during installation. Cover floor and wall areas at mixing stations.

3.03 APPLICATION

A. General: Mix and apply flooring components according to manufacturer's written instructions.

B. Apply a minimum of 2 coats in accordance with manufacturer's recommended coverage rates.

3.04 CURING

A. Cure flooring materials according to manufacturer's directions, taking care to prevent contamination during application stages and before completing curing process.

3.05 CLEANING AND PROTECTION

A. Clean as recommended by the manufacturer. Do not use materials or methods which may damage surface or surrounding construction.

B. Remove temporary covering and clean flooring prior to final inspection. Use cleaning materials and procedures recommended by flooring manufacturer.

C. Do not permit traffic over finished flooring surfaces.

D. Protect flooring materials from damage and wear during construction operation.

END OF SECTION

SECTION 09 65 00
RESILIENT FLOORING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

A. Resilient base and accessories.

1.03 SUBMITTALS

A. Samples: Samples of tile, sheet vinyl, base and edge strips for color and pattern selection.

B. Product Data: Manufacturer's printed installations on the following: Primer, adhesive, resilient tile, sheet vinyl and base material.

C. Certification: Manufacturer's certification that primers and adhesives are recommended for flooring material over concrete subfloor.

D. Provide manufacturer's maintenance recommendations for inclusion in Operations and Maintenance Manual.

1.04 ENVIRONMENTAL CONDITIONS

A. Temperature: Maintain temperatures of materials and areas in which flooring materials are to be installed between 65°F and 100°F from 48 hours before to 48 hours after installation. Maintain a minimum temperate of 55°F thereafter in accordance with the manufacturers' instructions.

PART 2 PRODUCTS

2.01 BASE MATERIALS

A. Manufacturers:
   1. Roppe Rubber Corp.
   2. Johnsonite Rubber Co.
   3. Armstrong Co.

B. Base: Standard Specification F-1861, Type TP, Group 2; 4" high; 1/8" thick; in lengths of 120'.
   1. Straight (no toe) at walls where carpet is scheduled for the adjacent floor and Cove (standard toe) at other locations.
   2. Minimum 100' long lengths.

C. Color: As selected by Architect.

2.02 ACCESSORIES

A. Primers and Adhesives: Waterproof, type recommended by floor material manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Apply primer to surfaces as recommended by manufacturer.

3.02 INSTALLATION - BASE MATERIAL

A. Adhere base tight to wall and floor surfaces, with adhesive as recommended by base manufacturer.

B. Fit joints tight and vertical. Miter internal corners. Hold joints minimum of 12" away from internal or external corners.

C. In areas scheduled for straight base, the base shall be installed prior to any flooring materials and protected during installation of flooring material. No other order of installation will be accepted.

3.03 EXTRA MATERIAL

A. Upon Completion and Acceptance of the Project the Contractor shall deliver to the Owner extra materials as follows:
   1. Rubber Base: 40 l.f. of each color.

3.04 CLEAN UP

A. Remove excess adhesive from surfaces without damage.

B. Clean in accordance with manufacturer's instructions.

END OF SECTION

SECTION 09 90 00
PAINTING AND COATING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

A. Surface preparation and field application of paints and coatings.

B. Surfaces To Be Painted: Complete coverage of all exposed surface is intended, unless specifically noted, not to be painted on the Drawings.

C. Related Sections: Section 09 96 00 – High Performance Coating

1.03 SYSTEM DESCRIPTION

A. Finish Materials: Conform to applicable code for flame/fuel/smoke rating requirements.

1.04 SUBMITTALS

A. Product Data: Provide data on all finishing products scheduled.

B. Samples:
   1. Submit two (2) 12" x 12" texture samples as required by the Architect for approval.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Store and apply materials in environmental conditions required by manufacturer's instructions.

1.06 MATERIALS AND EQUIPMENT NOT TO BE PAINTED

A. Do not paint the following items, unless noted otherwise:
   1. Factory-finished materials and equipment.
   2. Non-ferrous metals, except for items indicated to be painted.
   3. Moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sensing devices, motor or fan shafts.
   4. Code required labels such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, instructions, name or nomenclature plates.
   5. Duct shafts, concealed spaces and concealed pipes and ducts.
   6. Acoustical tile and suspension system, unless otherwise noted.
   7. Concrete floors.
   8. Structural steel work concealed by interior building finishes.
   9. Plastic laminate or solid polymer.
   10. Synthetic Stucco
   11. Prefinished Aluminum frames.
   12. Glass.

PART 2 PRODUCTS

2.01 PAINT

A. Refer to Paint Schedule at the end of this Section for schedule of products. Listed products are manufactured by the Sherwin Williams Company.

B. Manufacturers:
   1. Sherwin-Williams
   2. ICI
   3. Benjamin Moore & Co.
   4. Kelly-Moore

C. Coatings: Ready mixed, except field catalyzed coatings, of good flow and brushing properties, capable of drying or curing free of streaks or sags.

D. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials required to achieve the finishes specified.

PART 3 EXECUTION

3.01 GENERAL

A. All painting shall be performed by professional experienced workman in accordance with manufacturer's requirements and recommendations.

3.02 EXAMINATION AND PREPARATION

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

B. Measure moisture content of porous surfaces using an electronic moisture meter. Do not apply finishes unless moisture content is less than 15%.

C. Correct minor defects and clean surfaces which affect the work of this Section.

D. Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

E. Carefully examine the Drawings for areas in the existing building scheduled to be remodeled. Repaint existing surfaces where scheduled and/or required for a finished appearance. Paint shall be as herein specified. Areas requiring patching shall be finished to match adjacent surfaces unless scheduled otherwise. In remodeled areas of existing building and where existing painted surfaces are cut and patched as part of this contract the entire wall, door, frame, cabinet, etc. shall be painted. Spot, touch-up painting will not be acceptable unless approved in writing by the Architect.

3.03 SURFACE PREPARATION

A. Gypsum Board Surfaces: Latex fill minor defects. Spot prime defects after repair.

B. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.

C. Concrete and Unit Masonry Surfaces Scheduled to Receive Paint Finish: Remove foreign matter. Remove oil and grease with a solution of tri-sodium phosphate, rinse well and allow to dry.

D. Uncoated Ferrous Surfaces: Remove scale by wire brushing or sandblasting; wash clean with solvent. Apply treatment of phosphoric acid solution. Prime paint after repairs.

E. Shop-Primed Steel Surfaces: Sand and scrape to remove loose primer and rust, feather edges; clean surfaces with solvent. Prime bare steel surfaces.

F. Interior Wood Items Scheduled to Receive Paint Finish: Wipe surface clean; seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried, sand between coats.

G. Prefinished Metal Surfaces Scheduled to Be Painted: Dull surface by sanding, sandblasting or other abrasive method meeting manufacturer's instructions. Clean and prepare as required to receive new paint.

H. Interior Wood Items Scheduled 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.

3.05 APPLICATION

A. Sand transparent finishes lightly between coats to achieve required finish.

B. Where transparent finishes are specified, tint fillers to match wood.

C. When undercoats, stains or other conditions show through final paint coat, apply additional coats until paint film is of uniform finish, color and appearance.

D. Apply the finish coat to gypsum board, plaster, and concrete surfaces with rollers.

E. All interior wood trim shall be back primed before installation with enamel undercoat; or penetrating sealer, as required.

F. The number of paint coats specified is intended to cover surfaces perfectly. If surfaces are not so covered, additional coats shall be applied as required for complete coverage at no additional cost.

G. Back prime interior woodwork scheduled to receive transparent finish with gloss varnish reduced twenty-five percent (25%) with mineral spirits.

3.06 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

A. Color code items in accordance with Owner's established color code.

B. Paint shop-primed equipment.

C. Remove unfinished louvers, grilles, covers, and access panels and paint separately. Paint dampers exposed behind louvers, grilles, convector and baseboard cabinets to match face panels.

D. Prime and paint all pipes and insulated pipes, ducts and insulated ducts, hangers, brackets, collars and supports exposed in mechanical and electrical rooms, and other rooms with no ceiling, except where items are prefinished.

E. Paint interior surfaces of air ducts, convectors, and baseboard heating cabinets that are visible through grilles and louvers with one (1) coat of flat black paint, to limit of sight line.

F. Paint exposed conduit and electrical equipment occurring in finished areas, except prefinished surfaces.

G. Paint both sides and edges of plywood backboards.

3.07 TOUCH UP AND CLEANING

A. Touching Up:
   1. On completion, carefully touch up all holidays, marred and damaged spots, and work over all surfaces that have been repaired by other trades.
   2. Repaint the entire wall rather than spot-finish where portion of finish is damaged or is unsatisfactory.

B. Cleaning: Remove spilled, splashed, and splattered paint from all surfaces. Do not mar the surface finish of item being cleaned.

C. Replace electrical plates, hardware, light fixture trim, and fittings removed prior to finishing.

3.09 PAINT SCHEDULE - INTERIOR SURFACES

A. Gypsum Board:
   1. Surface Treatment: Refer to Section 09 21 16.
   2. One (1) coat S-W PrepRite 400 Latex Primer B28W400.
   3. Two (2) coats S-W Pro Mar 200 Latex Egg-Shell Enamel B20W200.

END OF SECTION

SECTION 09 96 00
HIGH PERFORMANCE COATINGS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

A. Surface preparation and finishing of walls and ceilings where scheduled on the Drawings as "epoxy paint".

B. Related Sections: Section 09 90 00 – Painting and Coating

1.03 SYSTEM DESCRIPTION

A. Finish Materials: Conform to applicable code for flame/fuel/smoke rating requirements.

B. Code Approval: Materials shall be approved by the Authority Having Jurisdiction codes for type of application.

1.04 SUBMITTALS

A. Samples: Two (2) samples 9" x 11" of each color scheduled.

B. Product Data: Manufacturer's literature including application instructions, material composition, test data, etc. for material being considered.

C. Certification of compliance with the Authority Having Jurisdiction codes.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Store and apply materials in environmental conditions required by manufacturer's instructions.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Glazed Paint Manufacturers: The Sherwin Williams Co. or approved substitution.

B. Source: Provide all products from one manufacturer unless noted specifically otherwise.

C. Coatings: Ready mixed, except field catalyzed coatings, of good flow and brushing properties, capable of drying or curing free of streaks or sags.

D. Accessory Materials:
   1. All materials required to achieve the finishes specified.
   2. All required ladders, scaffolding, drop cloths, masking, scrapers, tools, sandpaper, dusters, cleaning solvents and other items required to perform work and achieve results herein specified.

PART 3 – EXECUTION

3.01 EXAMINATION AND PREPARATION

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

B. Measure moisture content of porous surfaces using an electronic moisture meter.

C. Correct minor defects and clean surfaces which affect the work of this Section.

D. Gypsum Board Surfaces: Latex fill minor defects. Spot prime defects after repair.

E. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.

F. Concrete Surfaces:
   1. Remove foreign matter. Remove oil and grease with a solution of tri-sodium phosphate, rinse well and allow to dry.

2. For Epoxy Sealer, remove laitance by acid etching. Apply liberally, rinse thoroughly by scrubbing with fresh water and allow to dry. Fill cracks and voids by repainting or other approved methods.

G. Uncoated Ferrous Surfaces: Remove scale by wire brushing or sandblasting; wash clean with solvent. Apply treatment of phosphoric acid solution. Prime paint after repairs.

H. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust, feather edges; clean surfaces with solvent. Prime bare steel surfaces.

I. Interior Wood Items: Wipe surface clean; seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried, sand between coats.

J. Time Between Surface Preparation and Painting: Apply a coat of specified first coat material as soon as practical after surface preparation has been completed, but in any event, prior to any deterioration of prepared surface.

K. All surface preparation shall be in accordance with the manufacturer's directions.

3.02 COLORS

A. The architect will prepare a schedule of colors.

B. Mix finish materials accurately to obtain the colors scheduled.

3.03 APPLICATION

A. Mix and thin materials in accordance with the manufacturers printed instructions.

B. Apply materials at specified film thickness by method recommended by the manufacturer.

C. Allow each coat to dry thoroughly before recoating.

D. Vary color slightly for each successive coat.

E. Cut in edges clean and sharp where work joins other materials or colors.

F. Make finish coats smooth, uniform in color, and free of brush marks, laps, runs, dry, spray, overspray and skipped or missed areas.

3.04 INSPECTION

A. Request acceptance of each coat before applying succeeding coats.

B. Touch-up and repair all work that is not acceptable to the Architect and request final acceptance.

3.05 PAINTING SCHEDULE

A. Gypsum Wallboard:
1. Primer: (1) Coat: ProMar 200 Zero VOC Interior Latex Primer (B28W2600)
2. Two (3) Coats: SW Waterbased Catalyzed Epoxy (B73V300 series).

B. Wood:
1. One (1) Coat: S-W Premium Wall and Wood Primer (B28W811).
2. Two (3) Coats: S-W Water Based Catalyzed Epoxy (B73V300 series).

C. Metal:
1. Primer: (1) coat: SW Pro-Cryl Universal Metal Primer (B66-310 series).
2. Two (3) Coats: S-W Water Based Catalyzed Epoxy (B73V300 series).

D. Concrete Masonry Units:
1. Two (2) Coats: Kem Cati-Coat HS Epoxy Filler/Sealer, B42-400 Series (Number of coats may vary to fill voids, pinholes and provide a proper dense basecoat. Confirm with mockup and before application of finish coats.
2. Two (3) Coats: Macropoxy 646-100 Fast cure epoxy, B58-620

E. Tinting: Add tinting color in accordance with manufacturer's instructions to match scheduled colors.

3.06 CLEANING

A. Remove paint splatters from surfaces not scheduled for paintings.

B. Repair any damage to coating or surfaces caused by painting or cleaning operations.

C. Remove debris from job site and leave storage areas clean.

END OF SECTION

SECTION 11 53 13
LABORATORY FUME HOODS

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. Bench-top laboratory fume hoods.
2. Piping and wiring within fume hoods for service fittings, light fixtures, fan switches, and other electrical devices included with fume hoods.
3. Work tops within fume hoods.
4. Laboratory sinks and cup sinks in fume hoods.
5. Water, laboratory gas, and electrical service fittings in fume hoods.

B. Related Requirements:

1. Section 06 1000 "Rough Carpentry" for wood blocking for anchoring fume hoods.
2. Section 09 2216 "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring fume hoods.
3. Section 09 6513 "Resilient Base and Accessories" for resilient base applied to fume hood base cabinets.

1.3 COORDINATION

A. Coordinate layout and installation of framing and reinforcements for lateral support of fume hoods.

B. Coordinate installation of fume hoods with laboratory casework and other laboratory equipment.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For laboratory fume hoods.

1. Include plans, elevations, sections, and attachment details.
2. Indicate details for anchoring fume hoods to permanent building construction including locations of blocking and other supports.
3. Indicate locations and types of service fittings together with associated service supply connection required.
4. Indicate duct connections, electrical connections, and locations of access panels.
5. Include roughing-in information for mechanical, plumbing, and electrical connections.

6. Show adjacent walls, doors, windows, other building components, laboratory casework, and other laboratory equipment. Indicate clearances from the above items.
7. Include layout of fume hoods in relation to lighting fixtures and air-conditioning registers and grilles.
8. Include coordinated dimensions for laboratory equipment specified in other Sections.

C. Samples: For fume hood exterior finishes.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Showing compliance with specified performance requirements for as-manufactured containment and static pressure loss, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency.

B. Source quality-control reports.

C. Field quality-control reports.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish complete touchup kit for each type and color of fume hood finish provided. Include fillers, primers, paints, and other materials necessary to perform permanent repairs to damaged fume hood finish.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or another suitable material.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install fume hoods until building is enclosed, wet work and utility roughing-in are complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Locate concealed framing, blocking, and reinforcements that support fume hoods by field measurements before being enclosed, and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Restricted-Bypass Fume Hoods with VAV Control and Steel Exterior:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Kewaunee, Supreme Air Venturi Fume Hoods or comparable product by one of the following:

a. Air Master Systems Corporation.

b. Labconco Corporation.
c. Mott Manufacturing.

B. Source Limitations: Obtain laboratory fume hoods from single manufacturer.

1. Obtain laboratory fume hoods from same source as laboratory casework.

C. Product Designations: Drawings indicate sizes, types, and configurations of fume hoods by referencing designated manufacturer's catalog numbers. Other manufacturers' fume hoods of similar sizes, types, and configurations, and complying with the Specifications, may be considered. See Section 01 6000 "Product Requirements."

2.2 PERFORMANCE REQUIREMENTS

A. Containment: Provide fume hoods that comply with the following when tested according to ASHRAE 110 as modified below:

1. As-Manufactured (AM) Rating: AM 0.05 (0.05 ppm).
2. As-Installed (AI) Rating: AI 0.10 (0.10 ppm).
3. Average Face Velocity: 60 fpm plus or minus 10 percent with sashes fully open.
4. Face-Velocity Variation: Not more than 10 percent of average face velocity across the face opening with sashes fully open.
5. Sash Position: Fully open.

a. Test hoods with horizontal sashes with maximum opening on one side, with maximum opening in the center, and with one opening at each side equal to half of maximum opening.
b. Test hoods with combination sashes fully raised, with maximum opening on one side, with maximum opening in the center, and with one opening at each side equal to half of maximum opening.

6. Release Rate: 4.0 L/min.
7. Test Setup Modifications: Conduct tests with a minimum of three and a maximum of five people in the test room and with two 1-gal. round paint cans, one 12-by-12-by-12-inch cardboard box, and three 6-by-6-by-12-inch cardboard boxes in the fume hood during the test. Position items from 6 to 10 inches behind the sash, randomly distributed, and supported off the work surface by 2-by-2-inch blocks.
8. Walk-by Test: At the conclusion of containment test, execute three rapid walk-byes at 30-second intervals, 12 inches behind the mannequin. Test-gas concentration during each walk-by shall not exceed 0.1 ppm and shall return to specified containment value within 15 seconds.

B. Static-Pressure Loss: Not more than 1/2-inch wg at 60-fpm face velocity with sash fully open when measured at four locations 90 degrees apart around the exhaust duct and at least three duct diameters downstream from duct collar.

2.3 FUME HOODS

A. Product Standards: Comply with SEFA 1, "Laboratory Fume Hoods - Recommended Practices." Provide fume hoods UL listed and labeled for compliance with UL 1805.

B. Restricted-Bypass Fume Hoods: Provide restricted-bypass fume hoods. Partial compensating bypass above the sash opens after sash is closed to less than 20 percent open. Design partial bypass to maintain exhaust capacity of at least 25 cfm per sq. ft. of work surface regardless of sash position.

2.4 MATERIALS

A. Steel Sheet: Cold-rolled, commercial steel (CS) sheet, complying with ASTM A 1008/A 1008M; matte finish; suitable for exposed applications.

B. Glass-Fiber-Reinforced Polyester: Polyester laminate with a chemical-resistant gel coat on exposed faces, and having a flame-spread index of 25 or less according to ASTM E 84.

C. Epoxy: Factory molded, modified epoxy-resin formulation with smooth, nonspecular finish.

1. Physical Properties:

a. Flexural Strength: Not less than 10,000 psi.
b. Modulus of Elasticity: Not less than 2,000,000 psi.
c. Hardness (Rockwell M): Not less than 100.
d. Water Absorption (24 Hours): Not more than 0.02 percent.
e. Heat Distortion Point: Not less than 260 deg F.
f. Flame-Spread Index: 25 or less according to ASTM E 84.

2. Chemical Resistance: As follows when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.4.5:

a. No Effect: Acetic acid (98 percent), acetone, ammonium hydroxide (28 percent), benzene, carbon tetrachloride, dimethyl formamide, ethyl acetate, ethyl alcohol, ethyl ether, methyl alcohol, nitric acid (70 percent), phenol, sulfuric acid (60 percent), and toluene.
b. Slight Effect: Chromic acid (60 percent) and sodium hydroxide (50 percent).

3. Color: Gray.

D. Polypropylene: Unreinforced polypropylene complying with ASTM D 4101, Group 01, Class 1, Grade 2.

E. Glass: Clear, laminated tempered glass complying with ASTM C 1172, Kind LT, Condition A, Type I, Class I, Quality-Q3; with two plies not less than 3.0 mm thick and with clear, polyvinyl butyral interlayer.

1. Ultra clear Glass: Glass plies each have visible light transmission not less than 91 percent.
2. Safety Glass: Provide products complying with testing requirements in 16 CFR 1201 for Category II materials.
3. Permanently mark safety glass with certification label of the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

F. 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.

G. Fasteners: Provide stainless steel fasteners where exposed to fumes.

2.5 FABRICATION

A. General: Assemble fume hoods in factory to greatest extent possible. Disassemble fume hoods only as necessary for shipping and handling limitations. Fume hoods shall be capable of being partly disassembled as necessary to permit movement through a 35-by-79-inch door opening.

B. Steel Exterior: Fabricate from steel sheet, 0.048 inch thick, with component parts screwed together to allow removal of end panels, front fascia, and airfoil and to allow access to plumbing lines and service fittings. Apply chemical-resistant finish to interior and exterior surfaces of component parts before assembly.

C. Ends: Fabricate with double-wall end panels without projecting corner posts or other obstructions to interfere with smooth, even airflow. Close area between double walls at front of fume hood and as needed to house sash counterbalance weights, utility lines, and remote-control valves.

D. Splay top and sides of face opening to provide an aerodynamic shape to ensure smooth, even flow of air into fume hood.

E. Interior Lining: Provide one of the following unless otherwise indicated:

1. Glass-fiber-reinforced polyester, not less than 3/16 inch thick.

F. Lining Assembly: Unless otherwise indicated, assemble with stainless steel fasteners or epoxy adhesive, concealed where possible. Seal joints by filling with chemical-resistant sealant during assembly.

1. Fasten lining components together with stainless-steel cleats or angles to form a rigid assembly to which exterior panels are attached.
2. Fasten lining components to a rigid frame assembly fabricated from stainless steel and to which exterior panels are attached.
3. Punch fume hood lining side panels to receive service fittings and remote controls. Provide removable plug buttons for holes not used for indicated fittings.

G. Rear Baffle: Unless otherwise indicated, provide baffle, of same material as fume hood lining, at rear of hood with openings at top and bottom. Secure baffle to cleats at rear of hood with stainless-steel screws. Fabricate baffle for easy removal for cleaning behind baffle.

1. Provide preset baffles.
2. Provide epoxy-coated, stainless steel screen at bottom baffle opening to prevent paper from being drawn into the exhaust plenum behind baffles.

H. Exhaust Plenum: Full width of fume hood and with adequate volume to provide uniform airflow from hood, of same material as hood lining, and with duct stub for exhaust connection.

1. Duct-Stub Material: stainless steel or glass-fiber-reinforced polyester.

I. Bypass Grilles: Provide grilles at bypass openings of fume hoods.

J. Sashes: Provide operable sashes of type indicated.

1. Fabricate from 0.050-inch-thick stainless steel. Form into four-sided frame with bottom corners welded and finished smooth. Make top member removable for glazing replacement. Set glazing in chemical-resistant, U-shaped gaskets.
2. Glaze with laminated safety glass.
3. Counterbalance vertical-sliding sash with sash weight and stainless-steel cable system to hold sash in place regardless of position. Provide ball-bearing sheaves, plastic glides in stainless steel guides, and stainless-steel lift handles. Provide rubber bumpers at top and bottom of each sash unit.

K. Airfoil: Unless otherwise indicated, provide airfoil at bottom of fume hood face opening with 1-inch space between airfoil and work top. Sash closes on top of airfoil, leaving 1-inch opening for air intake. Airfoil directs airflow across work top to remove heavier-than-air gases and to prevent reverse airflow.

1. Fabricate airfoil from stainless-steel.

L. Light Fixtures: Provide vaporproof, two-tube, rapid-start, fluorescent light fixtures, of longest practicable length; complete with tubes at each fume hood. Shield tubes from hood interior with 1/4-inch-thick laminated glass or 3-mm-thick tempered glass, sealed into hood with chemical-resistant rubber gaskets. Provide units with fluorescent tubes easily replaceable from outside of fume hood.

1. Provide fluorescent tubes with color temperature of 3500 K and minimum color-rendering index of 85.

M. Filler Strips: Provide as needed to close spaces between fume hoods or fume hood base cabinets and adjacent building construction. Fabricate from same material and with same finish as fume hoods or fume hood base cabinets, as applicable.

N. Ceiling Extensions: Provide filler panels matching fume hood exterior to enclose space above fume hoods at front and sides of fume hoods and extending from tops of fume hoods to ceiling.

O. Finished Back Panels: Where rear surfaces of fume hoods are exposed to view, provide finished back panels matching rest of fume hood enclosure.

P. Comply with requirements in other Sections for installing water and laboratory gas service fittings, piping, electrical devices, and wiring. Install according to Shop Drawings. Securely anchor fittings, piping, and conduit to fume hoods unless otherwise indicated.

2.6 FUME HOOD BASE CABINETS BASE STANDS WORK TOPS SINKS AND SERVICE FITTINGS

A. Comply with Section 12 3553 "Metal Laboratory Casework." Provide metal base cabinets in finish matching fume hood exterior finish.

B. Work Tops: Epoxy.

1. Work-Top Configuration: Raised (marine) edge with rounded edge and corners.
2. Where acid storage cabinets are indicated beneath fume hoods, provide holes in work tops as need to accommodate cabinet vents.
3. Where epoxy sinks occur in epoxy work tops, provide integral sinks bonded to tops with invisible joint line.

C. Fume Hood Base Stands: Welded steel tubing legs, not less than 2 inches square with channel stretchers and aprons. Weld or bolt stretchers to legs and cross-stretchers, and bolt legs to aprons. Provide leveling device welded to bottom of each leg.

1. Structural Performance: Capable of withstanding 50-lb/ft. work top, 75 lb/ft. on work top, plus weight of hood, without permanent deformation or excessive deflection.
2. Leg Shoes: Black vinyl or rubber, open-bottom, slip-on type.

2.7 CHEMICAL-RESISTANT FINISH

A. General: Prepare, treat, and finish welded assemblies after welding. Prepare, treat, and finish components that are to be assembled with mechanical fasteners before assembling. Prepare, treat, and finish concealed surfaces same as exposed surfaces.

B. Preparation: Clean steel surfaces, other than stainless-steel, of mill scale, rust, oil, and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it.

C. Chemical-Resistant Finish: Immediately after cleaning and pretreating, apply fume hood manufacturer's standard two-coat, chemical-resistant, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.

1. Chemical and Physical Resistance of Finish System: Finish complies with acceptance levels of cabinet surface finish tests in SEFA 8M. Acceptance level for chemical spot test shall be no more than four Level 3 conditions.
2. Colors for Fume Hood Finish: As selected by Architect from manufacturer's full range.

2.8 ACCESSORIES

A. Sash Alarm: Provide fume hoods with audible and visual alarm that activates when sash is opened beyond preset position.

1. Provide with silence and test switches.

B. Sash Stops: Provide fume hoods with sash stops to limit hood opening to 50 percent of sash height. Sash stops can be manually released to open sash fully for cleaning fume hood and for placing large apparatus within fume hood.

2.9 SOURCE QUALITY CONTROL

A. Demonstrate fume hood performance before shipment by testing fume hoods according to ASHRAE 110 as modified in "Performance Requirements" Article. Provide testing facility, instruments, equipment, and materials needed for tests.

2.10 SNORKEL EXHAUST HOODS

A. Basis of Design Product: Subject to compliance with requirements, provide Nederman Extraction Arms, Model FX 75 or comparable product.

1. Mounting: Ceiling, connection up. Provide mounting brackets and extensions for a complete installation.
2. Hood: Transparent Combi-hood

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 fume hoods.

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

3.2 INSTALLATION

A. General: Install fume hoods according to manufacturer's written instructions. Install level, plumb, and true; shim as required, using concealed shims, and securely anchor to building and adjacent laboratory casework. Securely attach access panels but provide for easy removal and secure reattachment. Where fume hoods abut other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.

B. Comply with requirements in Section 12 3553 "Metal Laboratory Casework" for installing fume hood base cabinets, work tops, and sinks.

C. Comply with requirements for installing water and laboratory gas service fittings and electrical devices.

1. Install fittings according to Shop Drawings, installation requirements in SEFA 2.3, and manufacturer's written instructions. Set bases and flanges of sink and work top-mounted fittings in sealant recommended by manufacturer of sink or work-top material. Securely anchor fittings to fume hoods unless otherwise indicated.

3.3 ADJUSTING AND CLEANING

A. Adjust moving parts for smooth, near silent, accurate sash operation with one hand. Adjust sashes for uniform contact of rubber bumpers. Verify that counterbalances operate without interference.

B. Clean finished surfaces, including both sides of glass; touch up as required; and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

END OF SECTION

SECTION 12 35 53.19

WOOD LABORATORY CASEWORK

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Wood laboratory casework.
   2. Utility-space framing at backs of base cabinets.
   3. Filler and closure panels.
   4. Laboratory casework system that includes support and utility-space framing, filler and closure panels, and modular countertops.
   5. Laboratory countertops.
   6. Tables.
   7. Shelves.
   8. Laboratory sinks and troughs.
   9. Laboratory accessories.
   10. Water and electrical service fittings.

1.02 DEFINITIONS

A. Concealed Surfaces of Casework: Include sleepers, web frames, dust panels, and other surfaces not usually visible after installation.

B. Exposed Surfaces of Casework: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches (1200 mm) above floor, and visible surfaces in open cabinets or behind glass doors.
   1. Ends of cabinets are defined as "exposed" except ends are defined as "concealed" where installed directly against and completely concealed by walls or other cabinets.

C. Semi exposed Surfaces of Casework: Surfaces behind opaque doors, such as cabinet interiors, shelves, and dividers; interiors and sides of drawers; and interior faces of doors. Tops of cases 78 inches (1980 mm) or more above floor and bottoms of cabinets more than 24 inches (600 mm) but less than 48 inches (1200 mm) above floor are defined as "semi exposed."

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

B. Keying Conference: Conduct conference at Project site. Incorporate keying conference decisions into final keying requirements.

1.04 COORDINATION

A. Coordinate layout and installation of framing and reinforcements for support of laboratory casework.

B. Coordinate installation of laboratory casework with installation of laboratory equipment.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For laboratory casework.
   1. Include plans, elevations, sections, and attachments to other work including blocking and reinforcements required for installation.
   2. Indicate types and sizes of casework.
   3. Indicate manufacturer's catalog numbers for casework.
   4. Show fabrication details, including types and locations of hardware.
   5. Indicate locations and types of service fittings.
   6. Include details of utility spaces showing support for conduits and piping.
   7. Include details of support framing system.
   8. Include details of exposed conduits, if required, for service fittings.

9. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and laboratory equipment.
10. Include coordinated dimensions for laboratory equipment specified in other Sections.

C. Keying Schedule: Include schematic keying diagram and index each key set to unique designations that are coordinated with the Contract Documents.

D. Samples: For casework finishes and materials requiring color selection.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Product Test Reports:

1. Casework: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of laboratory casework with requirements of specified product standard and system structural performance specified in "Performance Requirements" Article.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish complete touchup kit for each type and color of casework finish provided. Include fillers, stains, finishes, and other materials necessary to perform permanent repairs to damaged laboratory casework finish.

B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Cabinet Mounting Clips and Related Hardware: Quantity equal to 5 percent of amount installed, but no fewer than 20 of each type.

1.08 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that produces casework of types indicated for this Project that has been tested for compliance with SEFA 8 W.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or other suitable material.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install laboratory casework until building is enclosed, utility roughing-in and wet-work are complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

B. Established Dimensions: Where laboratory casework is indicated to fit to other construction, establish dimensions for areas where casework is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

C. Field Measurements: Where laboratory casework is indicated to fit to existing construction, verify dimensions of existing construction by field measurements before fabrication and indicate measurements on Shop Drawings. Provide fillers and scribes to allow for trimming and fitting.

D. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before enclosing them and indicate measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Diversified Woodcrafts, Inc.
2. Kewaunee Scientific Corporation.

3. Leonard Peterson & Company, Inc.
4. Terrill Manufacturing Company.

B. Source Limitations: Obtain laboratory casework from single source from single manufacturer unless otherwise indicated.
   1. Obtain countertops sinks accessories and service fittings from casework manufacturer.

C. Product Designations: Drawings indicate sizes and configurations of laboratory casework by referencing designated manufacturer's catalog numbers. Other manufacturers' laboratory casework of similar sizes and similar door and drawer configurations and complying with the Specifications may be considered. See Section 016000 "Product Requirements."

2.2 PERFORMANCE REQUIREMENTS

A. System Structural Performance: Laboratory casework and support framing system shall withstand the effects of the following gravity loads and stresses without permanent deformation, excessive deflection, or binding of drawers and doors:
   1. Support Framing System: 600 lb/ft. (900 kg/m).
   2. Suspended Base Cabinets (Internal Load): 160 lb/ft. (240 kg/m).
   3. Work Surfaces (Including Tops of Suspended Base Cabinets): 160 lb/ft. (240 kg/m).
   4. Wall Cabinets (Upper Cabinets): 160 lb/ft. (240 kg/m).
   5. Shelves: 40 lb/sq. ft. (200 kg/sq. m).

2.3 CASEWORK, GENERAL

A. Casework Product Standard: Comply with SEFA 8 W, "Laboratory Grade Wood Casework."

B. Flammable Liquid Storage: Where cabinets are indicated for solvent or flammable liquid storage, provide units that are listed and labeled as complying with requirements in NFPA 30 by a testing and inspecting agency acceptable to authorities having jurisdiction.

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.

2.4 WOOD CASEWORK

A. Design: Lipped overlay with radiused edges.
   1. Provide 1/8-inch (3.2-mm) reveals between doors and drawers that are adjacent.

B. Wood Species: Maple.
   1. Wood Stain Colors and Finishes: As selected by Architect from casework manufacturer's full range.

C. Cut: Plain sliced/sawn.

D. Grain Direction:
   1. Doors: Vertical with continuous vertical matching.
   2. Drawer Fronts: Vertical with continuous vertical matching.

E. Exposed Materials:
   1. General: Provide materials that are selected and arranged for compatible grain and color. Do not use materials adjacent to one another that are noticeably dissimilar in color, grain, figure, or natural character markings.
   2. Plywood: Hardwood plywood, either veneer core or particleboard core with face veneer of species indicated. Grade A exposed faces, at least 1/50 inch (0.5 mm) thick, and Grade J crossbands. Provide backs of same species as faces.
   3. Solid Wood: Clear hardwood lumber of species indicated.
   4. Edge banding: Solid wood, minimum 1/8 inch (3 mm) thick and of same species as face veneer.

F. Semi exposed Materials:
   1. Wood: Provide solid wood or hardwood plywood for semi exposed surfaces unless otherwise indicated.

G. Concealed Materials:
   1. Plywood: Hardwood plywood. Provide backs of same species as faces.
   2. MDF.

2.5 WOOD CABINET AND TABLE MATERIALS

A. General:
   1. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.

B. Hardwood Plywood: HPVA HP-1, particleboard core except where veneer core is indicated.

C. MDF: Medium-density fiberboard, ANSI A208.2, Grade 130.

D. Particleboard: ANSI A208.1, Grade M-2.

E. Straw-Based Particleboard: ANSI A208.1, Grade M-2, except for density.

F. Hardboard: ANSI A135.4, Class 1 tempered.

G. PVC Edge banding for Wood: Rigid PVC extrusions, through color with satin finish, 0.12 inch (3 mm) thick at doors and drawer fronts, 0.04 inch (1 mm) thick elsewhere.

2.6 AUXILIARY CABINET MATERIALS

A. Acid Storage-Cabinet Lining: 1/4-inch- (6-mm-) thick, polyethylene, polypropylene, epoxy, or phenolic- composite lining material.

B. Glass for Glazed Doors: Clear tempered glass complying with ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality-Q3; not less than 5.0 mm thick.

2.7 CABINET HARDWARE

A. General: Provide laboratory casework manufacturer's standard, commercial-quality, heavy-duty hardware complying with requirements indicated for each type.

B. Butt Hinges: Stainless -steel, five-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide two for doors 48 inches (1200 mm) high or less and three for doors more than 48 inches (1200 mm) high.

C. Frameless Concealed Hinges (European Type): BHMA A156.9, Type B01602. Provide two for doors 48 inches (1200 mm) high or less and three for doors more than 48 inches (1200 mm) high.
   1. Degrees of Opening: 135.

D. Hinged-Door and Drawer Pulls: Stainless-steel, back-mounted pulls. Provide two pulls for drawers more than 24 inches (600 mm) wide.
   1. Design: As selected from the manufacturer’s full range.
   2. Overall Size: As selected from manufacturer's full range.

E. Sliding-Door Pulls: Stainless-steel recessed flush pulls.
   1. Design and Size: As selected from manufacturer's full range.

F. Recessed Pulls: Aluminum. Provide two pulls for drawers more than 24 inches (600 mm) wide.

G. Channel Pulls: Full-width recessed solid-hardwood channels; matching exposed wood of cabinets.

H. Door Catches: Nylon-roller Spring catches. Provide two catches on doors more than 48 inches (1200 mm) high.

I. Drawer Slides: Side mounted, epoxy-coated steel, self-closing; designed to prevent rebound when drawers are closed; complying with BHMA A156.9, Type B05091.
   1. Provide Grade 1; for drawers not more than 6 inches (150 mm) high and 24 inches (600 mm) wide.
   2. Provide Grade 1HD-100; for drawers more than 6 inches (150 mm) high or 24 inches (600 mm) wide.

3. Standard Duty (Grade 1): Full -extension type, with polymer rollers.
4. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Full -extension, ball-bearing type.

J. Drawer Slides: Hardwood runners under centers of drawers with polymer guides fastened to backs of drawers.

K. Label Holders: Stainless steel, aluminum, or chrome plated; sized to receive standard label cards approximately 1 by 2 inches (25 by 50 mm), attached with screws or rivets. Provide on drawers.

L. Locks: Cam type, brass with chrome-plated finish; complying with BHMA A156.11, Type E07281.
1. Tumbler: Disc.
2. Lock Locations: Provide 50 percent of drawers and doors.
3. Keying: Key locks alike within each room.
4. Key Quantity: Minimum of two keys per lock.

M. Sliding-Door Hardware Sets: Laboratory casework manufacturer's standard, to suit type and size of sliding-door units.

N. Adjustable Shelf Supports: BHMA A156.9, powder-coated steel standards, surface type, and epoxy powder-coated steel shelf brackets, Type B04102 and Type B04112.

2.8 COUNTERTOP TABLETOP, SHELF, TROUGH, AND SINK MATERIALS

A. Epoxy: Factory-molded, modified epoxy-resin formulation with smooth, non-specular finish.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. Durcon Incorporated.
b. Prime Industries, Inc.
2. Physical Properties:
a. Flexural Strength: Not less than 10,000 psi (70 MPa).
b. Modulus of Elasticity: Not less than 2,000,000 psi (1400 MPa).
c. Hardness (Rockwell M): Not less than 100.
d. Water Absorption (24 Hours): Not more than 0.02 percent.
e. Heat Distortion Point: Not less than 260 deg F (127 deg C).
3. Chemical Resistance: Epoxy-resin material has the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.4.5:
a. No Effect: Acetic acid (98 percent), acetone, ammonium hydroxide (28 percent), benzene, carbon tetrachloride, dimethyl formamide, ethyl acetate, ethyl alcohol, ethyl ether, methyl alcohol, nitric acid (70 percent), phenol, sulfuric acid (60 percent), and toluene.
b. Slight Effect: Chromic acid (60 percent) and sodium hydroxide (50 percent).
4. Color: As selected by Architect from epoxy manufacturer's full range.

2.9 WOOD CABINET AND TABLE FABRICATION

A. Construction: Provide wood-faced laboratory casework complying with SEFA 8 W.
1. Bottoms of Base Cabinets and Tall Cabinets: 3/4-inch- (19-mm-) thick, hardwood plywood.
2. Tops and Bottoms of Wall Cabinets and Tops of Tall Cabinets: 1-inch- (25-mm-) thick, veneer-core hardwood plywood.
3. Ends of Cabinets: 3/4-inch- (19-mm-) thick, hardwood plywood.
4. Shelves: 1-inch- (25-mm-) thick, veneer-core hardwood plywood.
5. Base Cabinet Top Frames: 3/4-by-2-inch (19-by-50-mm) solid wood with mortise and tenon or doweled connections, glued and pinned or screwed.
6. Base Cabinet Stretchers: 3/4-by-4-1/2-inch (19-by-114-mm) panel product strips or solid-wood boards at front and back of cabinet, glued and pinned or screwed. May be provided as an option to base cabinet top frames.
7. Exposed Backs of Cabinets: 3/4-inch- (19-mm-) thick, hardwood plywood.

8. Unexposed Backs of Cabinets: 1/4-inch- (6.4-mm-) thick, hardwood plywood dado into sides, bottoms, and tops unless otherwise indicated.
9. Drawer Fronts: 3/4-inch- (19-mm-) thick, hardwood plywood or solid hardwood.
10. Drawer Sides and Backs: 1/2-inch- (13-mm-) thick, solid hardwood or hardwood plywood, with glued dovetail or multiple-dowel joints.
11. Drawer Bottoms: 1/4-inch- (6.4-mm-) thick, veneer-core hardwood plywood glued and dado into front, back, and sides of drawers.
12. Drawer Bodies: Steel drawer pans formed from 0.036-inch- (0.91-mm-) thick metal, metallic phosphate treated, and finished with manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat with a minimum dry film thickness of 1 mil (0.025 mm) for topcoat and 2 mils (0.05 mm) for system.
13. Doors 48 Inches (1200 mm) High or Less: 3/4 inch (19 mm) thick, with particleboard or MDF cores and hardwood face veneers and crossbands.
14. Doors More Than 48 Inches (1200 mm) High: 1-1/16 inches (27 mm) thick, with honeycomb cores, solid-hardwood stiles and rails, and hardwood face veneers and crossbands.
15. Stiles and Rails of Glazed Doors 48 Inches (1200 mm) High or Less: 3/4 inch (19 mm) thick.
    a. Material: Solid hardwood.
16. Stiles and Rails of Glazed Doors More Than 48 Inches (1200 mm) High: 1-1/16-inch- (27-mm-) thick, solid wood with hardwood face veneers and crossbands.

B. Tables: Solid-hardwood legs, not less than 2 inches (50 mm) square with solid-hardwood stretchers as needed to comply with product standard. Bolt stretchers to legs and cross-stretchers, and bolt legs to table aprons. Provide a leveling device at bottom of each leg.
    1. Leg Shoes: Black vinyl or rubber, open-bottom, slip-on type.

C. Utility-Space Framing: Steel framing units consisting of two steel slotted channels complying with MFMA-4, not less than 1-5/8 inches (41 mm) square by 0.105-inch (2.66-mm) nominal thickness, that are connected at top and bottom by U-shaped brackets made from 1-1/4-by-1/4-inch (32-by-6-mm) steel flat bars. Framing units may be made by welding channel material into rectangular frames instead of using U- shaped brackets.

D. Removable Backs: Provide backs that can be removed from within cabinets at utility spaces.

E. Filler and Closure Panels: Provide where indicated and as needed to close spaces between casework and walls, ceilings, and equipment. Fabricate from same material and with same finish as adjacent exposed casework surfaces unless otherwise indicated.
    1. Provide knee-space panels (modesty panels) in spaces between base cabinets, where cabinets are not installed against a wall or where space is not otherwise closed.
    2. Provide utility-space closure panels at spaces between base cabinets where utility space would otherwise be exposed, including spaces below countertops.
    3. Provide closure panels at ends of utility spaces where utility spaces would otherwise be exposed.

2.10 LABORATORY CASEWORK SYSTEM

A. Provide casework manufacturer's standard integrated system that includes support framing, suspended modular wood cabinets, filler and closure panels, countertops, and fittings needed to assemble system. System includes hardware and fasteners for securing support framing to permanent construction.
    1. Cabinets can be removed and reinstalled without the use of special tools for relocation within the system.
    2. Base cabinets can be removed without providing temporary support for, or removing, countertops.
    3. Sinks are supported independent of base cabinets.
    4. Support framing has provision for fastening pipe supports at utility space in not more than 1-inch (25-mm) increments.

5. The system includes filler and closure panels to close spaces between support framing, cabinets, shelves, countertops, floors, and walls unless otherwise indicated. Fabricate from same material and with same finish as adjacent exposed cabinet surfaces unless otherwise indicated.

B. Support Framing: Casework manufacturer's standard system consisting of vertical supports and connecting braces and rails as follows:
   1. Cabinets, shelves, and countertops are supported from vertical supports except where floor-supported base cabinets are indicated. Vertical positioning of supported cabinets, shelves, and countertops can be varied in 1-inch (25-mm) increments through full height of supports.
   2. Vertical supports rest on adjustable leveling bases and are secured to the floor with metal clips fastened to floor.
   3. Vertical supports are installed with braces and rails, connecting them to each other and to permanent building walls to create a stable, rigid structure with framed utility spaces where indicated.

C. Countertops: Provide in modular lengths indicated, without seams.

2.11 WOOD FINISH

A. Preparation: Sand lumber and plywood before assembling. Sand edges of doors, drawer fronts, and molded shapes with profile-edge sander. Sand after assembling for uniform smoothness at least equivalent to that produced by 220-grit sanding and without machine marks, cross sanding, or other surface blemishes.

B. Staining: Remove fibers and dust and apply stain to exposed and semi exposed surfaces as necessary to match approved Samples. Apply stain to produce a consistent appearance. Apply wash-coat sealer before applying stain to closed-grain wood species.

C. Chemical-Resistant Finish: Apply laboratory casework manufacturer's standard two-coat, chemical-resistant, transparent finish. Sand and wipe clean between coats. Topcoat(s) may be omitted on concealed surfaces.
   1. Chemical and Physical Resistance of Finish System: Finish complies with acceptance levels of cabinet surface finish tests in SEFA 8 W. Acceptance level for chemical spot test shall be no more than for Level 3 conditions.

2.12 COUNTERTOPS, TABLETOPS, SHELVES , TROUGHS, AND SINKS

A. Countertops, General: Provide units with smooth surfaces in uniform plane, free of defects. Make exposed edges and corners straight and uniformly beveled. Provide front and end overhang of 1 inch (25 mm).

B. Sinks, General: Provide sizes indicated or laboratory casework manufacturer's closest standard size of equal or greater volume, as approved by Architect.
   1. Outlets: Provide strainers and tailpieces, NPS 1-1/2 (DN 40), unless otherwise indicated.
   2. Overflows: For each sink except cup sinks, provide overflow of standard beehive or open-top design with separate strainer. Height 2 inches (50 mm) less than sink depth. Provide in same material as strainer.

C. Epoxy Countertops, Tabletops, and Sinks:
   1. Countertop Fabrication: Fabricate with factory cutouts for sinks, holes for service fittings and accessories, and butt joints assembled with epoxy adhesive and concealed metal splines.
      a. Marine-Edge Configuration: 1-inch (25-mm) minimum thickness, with integral or applied raised edge.
         1) Edges and Corners: Beveled.
         2) Backsplash: Applied.
      b. Construction: Uniform throughout full thickness.
      c. Product Option: Phenolic-composite countertops may be substituted for epoxy countertops at Contractor's option.
   2. Tabletop Fabrication:

a. Flat Configuration: 1 inch (25 mm) thick with continuous drip groove on underside at perimeter.
1) Edges and Corners: Beveled.

3. Sink Fabrication: Molded in one piece with smooth surfaces, coved corners, and bottom sloped to outlet; 1/2-inch (13-mm) minimum thickness.
a. Provide polypropylene strainers and tailpieces.
b. Provide integral sinks in epoxy countertops, bonded to countertops with invisible joint line.
c. Provide sinks for drop-in installation with 1/4-inch- (6-mm-) thick lip around perimeter of sink.
d. Provide sinks for underside installation with manufacturer's recommended adjustable support system for table- and cabinet-type installations.

D. Cup Sinks: Provide in material indicated, 3-by-6-inch (75-by-150-mm) oval.

1. Epoxy Cup Sinks: Provide polypropylene strainers and integral tailpieces.

E. Troughs: Provide in material indicated and pitch to drains not less than 1/8 inch/foot (10 mm/m). Except where troughs empty into sinks, provide NPS 1-1/2 (DN 40) outlets with strainers and tailpieces.

1. Epoxy Troughs: Molded in one piece with smooth surfaces and coved corners; 1/2-inch (13-mm) minimum thickness. Provide polypropylene strainers and tailpieces.

2.13 LABORATORY ACCESSORIES

A. Reagent Shelves: Provide as indicated, fabricated from same material as adjacent countertop unless otherwise indicated.

B. Burette Rods: Aluminum or stainless-steel rods, 1/2 inch (13 mm) in diameter and 18 inches (450 mm) long, threaded on one end to fit tapered plug adapter for flush socket receptacle. Provide them with tapered plug adapter and receptacle.

C. Upright Rod Assembly and Metal Crossbar: Aluminum or stainless steel. Two vertical rods and one horizontal crossbar, 3/4 inch (19 mm) in diameter and 36 inches (900 mm) long unless otherwise indicated; two flush socket receptacles and two crossbar clamps. Ends of vertical rods are tapered to fit receptacles; other rod ends are rounded.

D. Greenlaw Arm Assembly: Aluminum or stainless-steel vertical rod, tapered on one end to fit flush socket receptacle. Adjustable crossbar of hardwood with black, acid-resistant finish, secured upright with adjustable clamp. Provide with receptacle.

E. Pegboards: Polypropylene, epoxy, or phenolic-composite pegboards with removable polypropylene pegs and stainless-steel drip troughs with drain outlet.

2.14 WATER SERVICE FITTINGS

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. Broen A/S.
2. Chicago Faucets; Geberit Company.
3. WaterSaver Faucet Co.

B. Service Fittings: Provide units that comply with SEFA 7, "Recommended Practices for Fixtures." Provide fittings complete with washers, locknuts, nipples, and other installation accessories. Include wall and deck flanges, escutcheons, handle extension rods, and similar items.
1. Provide units that comply with "Vandal-Resistant Faucets and Fixtures" recommendations in SEFA 7.

C. Materials: Fabricated from cast or forged red brass unless otherwise indicated.

1. Reagent-Grade Water Service Fittings: Polypropylene, PVC, or PVDF for parts in contact with water.

D. Finish: Chromium plated.

1. Provide chemical-resistant powder coating in laboratory casework manufacturer's standard metallic brown, aluminum, white, or other color as approved by Architect.

E. Water Valves and Faucets: Provide units complying with ASME A112.18.1, with renewable seats, designed for working pressure up to 80 psig (550 kPa).
1. Vacuum Breakers: Provide ASSE 1035 vacuum breakers on water fittings with serrated outlets.
2. Aerators: Provide aerators on water fittings that do not have serrated outlets.
3. Self-Closing Valves: Provide self-closing valves where indicated.

2.15 ELECTRICAL AND COMMUNICATION SERVICE FITTINGS

A. Service Fittings, General: Provide units complete with metal housings, receptacles, switches, pilot lights, data communication outlets, cover plates, accessories, and gaskets required for mounting on laboratory casework.

B. Electrical Wiring Devices: Comply with requirements in Electrical Engineer’s documents.

C. Twisted-Pair Copper Data Outlets: Comply with requirements in Electrical Engineer’s documents.

D. Optical Fiber Data Outlets: Comply with requirements in Electrical Engineer’s documents.

E. Receptacles:
1. Duplex Convenience Receptacles: 125 V, 20 A; NEMA WD 6, Configuration 5-20R.
   a. Standards: Comply with NEMA WD 1, UL 498, and FS W-C-596.
2. Hospital-Grade, Duplex Convenience Receptacles: 125 V, 20 A; NEMA WD 6, Configuration 5-20R.
   a. Standards: Comply with NEMA WD 1, UL 498 Supplement sd, and FS W-C-596.
3. Isolated-Ground, Duplex Convenience Receptacles: 125 V, 20 A; NEMA WD 6, Configuration 5- 20R.
   a. Standards: Comply with NEMA WD 1, UL 498, and FS W-C-596.
4. Tamper-Resistant, USB Charger Receptacles: 12 V dc, 2.0 A, USB Type A.
   a. Standards: Comply with NEMA WD 1, UL 498, UL 1310, and FS W-C-596.
   b. USB Receptacles: Single, Type A.
5. Hospital-Grade, USB Charger Receptacles: 12 V dc, 2.0 A, USB Type A.
   a. Standards: Comply with NEMA WD 1, UL 498 Supplement sd, UL 1310, and FS W-C-596.
   b. Marking: Labeled and complying with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.
6. USB Receptacles: Single, Type A.
7. Duplex GFCI Convenience Receptacles: 125 V, 20 A; NEMA WD 6, Configuration 5-20R, feed -through type with integral LED indicator light.
   a. Standards: Comply with NEMA WD 1, UL 498, UL 943 Class A, and FS W-C-596.
8. Hospital-Grade, Duplex GFCI Convenience Receptacles: 125 V, 20 A; NEMA WD 6, Configuration 5-20R, feed -through type with integral LED indicator light.
   a. Standards: Comply with NEMA WD 1, UL 498 Supplement sd, UL 943 Class A, and FS W-C-596.
9. Duplex SPD Convenience Receptacles: 125 V, 20 A; NEMA WD 6, Configuration 5-20R, with LED indicator light and integral SPD in line to ground, line to neutral, and neutral to ground.
   a. Standards: Comply with NEMA WD 1, UL 498, UL 1449, and FS W-C-596.
10. Isolated-Ground, Duplex SPD Convenience Receptacles: 125 V, 20 A; NEMA WD 6, Configuration 5-20R, with LED indicator light and integral SPD in line to ground, line to neutral, and neutral to ground.
    a. Standards: Comply with NEMA WD 1, UL 498, UL 1449, and FS W-C-596.

11. Hospital-Grade, Duplex SPD Convenience Receptacles: 125 V, 20 A; NEMA WD 6, Configuration 5-20R, with integral SPD in line to ground, line to neutral, and neutral to ground.
    a. Standards: Comply with NEMA WD 1, UL 498 Supplement sd, UL 1449, and FS W-C-596.
12. Isolated-Ground Hospital-Grade, Duplex SPD Convenience Receptacles: 125 V, 20 A; NEMA WD 6, Configuration 5-20R, with integral SPD in line to ground, line to neutral, and neutral to ground.
    a. Standards: Comply with NEMA WD 1, UL 498 Supplement sd, UL 1449, and FS W-C-596.
13. Color of Receptacles: As selected by Architect unless otherwise indicated or required by NFPA 70.

F. Switches:
1. Single-Pole Switches: 120/277 V, 20 A.
    a. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.
2. Two-Pole Switches: 120/277 V, 20 A.
    a. Comply with NEMA WD 1, UL 20, and FS W-S-896.
3. Pilot-Light Switches, Single Pole: 120/277 V, 20 A, with LED-lighted handle, illuminated when switch is off.
    a. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.
4. Key-Operated Switches: 120/277 V, 20 A; single pole, with factory-supplied key in lieu of switch handle.
    a. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.
5. Color of Switches: As selected by Architect unless otherwise indicated or required by NFPA 70.

G. Data Communication Outlets: Two RJ-45 jacks for terminating 100-ohm, balanced, four-pair twisted-pair cabling complying with TIA-568-C.1; complying with School IT Standard. Comply with UL 1863.

H. Cover Plates: Provide satin-finish, Type 304, stainless-steel cover plates with formed, beveled edges.

I. Cover-Plate Identification: Use 1/4-inch- (6-mm-) high letters unless otherwise indicated. For stainless steel or chrome-plated metal, stamp or etch plate and fill in letters with black enamel.
1. Provide at every cover plate.
    a. Receptacles other than standard 125-V duplex, grounding type.
    b. Switches and thermal-overload switches.
    c. Pilot lights when located remotely from associated equipment or switch, where function is not obvious.
    d. Receptacles, switches, and other locations indicated.
2. Provide the following information:
    a. Voltage and phase for receptacles other than standard 125-V duplex, grounding type.
    b. Indicate equipment being controlled by switches and thermal-overload switches.
    c. Indicate equipment being controlled for pilot lights when located remotely from associated equipment or switch, where function is not obvious.
    d. Number of the breaker in panelboard that controls device.

J. Pedestal-Type Fittings: Cast-aluminum housings with sloped single face or two faces, as indicated, with neoprene gasket under base and with concealed mounting holes in base for attaching to laboratory casework. Provide holes tapped for conduits.

K. Line-Type Fittings: Provide cast-metal boxes with threaded holes for mounting on rigid steel conduit. Provide cover plates same size as boxes.

L. Recessed-Type Fittings: Provide galvanized-steel boxes.

M. Finishes for Service-Fitting Components: Provide housings or boxes for pedestal- and line-type

fittings with manufacturer's standard baked-on, chemical-resistant enamel in color as selected by Architect from manufacturer's full range.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of the Work.

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

3.02 INSTALLATION OF CABINETS

A. Comply with installation requirements in SEFA 2. Install level, plumb, and true in line; shim as required using concealed shims. Where laboratory casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical. Do not exceed the following tolerances:
   1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet (1.5 mm in 3 m).
   2. Variation of Bottoms of Upper Cabinets from Level: 1/8 inch in 10 feet (3 mm in 3 m).
   3. Variation of Faces of Casework from a True Plane: 1/8 inch in 10 feet (3 mm in 3 m).
   4. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch (0.8 mm).
   5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch (1.5 mm).

B. Utility-Space Framing: Secure to floor with two fasteners at each frame. Fasten to partition framing, wood blocking, or metal reinforcements in partitions and to base cabinets.

C. Base Cabinets: Fasten cabinets to utility-space framing, partition framing, wood blocking, or reinforcements in partitions, with fasteners spaced not more than 16 inches (400 mm) o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform.
   1. Where base cabinets are installed away from walls, fasten to floor at toe space at not more than 24 inches (600 mm) o.c. and at sides of cabinets with not less than two fasteners per side.

D. Wall Cabinets: Fasten to hanging strips, masonry, partition framing, blocking, or reinforcements in partitions. Fasten each cabinet through back, near top, at not less than 16 inches (400 mm) o.c.

E. Install hardware uniformly and precisely.

F. Adjust operating hardware so doors and drawers align and operate smoothly without warp or bind and contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.

3.02 INSTALLATION OF COUNTERTOPS

A. Comply with installation requirements in SEFA 2. Abut top and edge surfaces true in plane with flush hairline joints and with internal supports placed to prevent deflection. Locate joints where indicated on Shop Drawings.

B. Field Jointing: Where possible, make in same manner as shop-made joints, using dowels, splines, fasteners, adhesives, and sealants recommended by manufacturer. Shop prepare edges for field-made joints.
   1. Plastic-Laminate Countertops: Secure field-made joints using concealed clamping devices located within 6 inches (150 mm) of front and back edges and at intervals not exceeding 24 inches (600 mm). Tighten according to manufacturer's written instructions to exert a uniform heavy pressure at joints.

C. Fastening:
   1. Secure epoxy countertops to cabinets with epoxy cement, applied at each corner and along perimeter edges at not more than 48 inches (1200 mm) o.c.

D. Provide holes and cutouts required for service fittings.

E. Provide scribe moldings for closures at junctures of countertop, curb, and splash with walls as recommended by manufacturer for materials involved. Match materials and finish to adjacent laboratory casework. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer.

F. Dress joints smooth, remove surface scratches, and clean entire surface.

3.03 INSTALLATION OF SINKS

A. Comply with installation requirements in SEFA 2.

B. Drop-in Installation of Epoxy Sinks: Rout groove in countertop to receive sink rim if not shop prepared. Set sink in adhesive and fill remainder of groove with sealant or adhesive. Use procedures and products recommended by sink and countertop manufacturers. Remove excess adhesive and sealant while still wet and finish joint for neat appearance.

C. Underside Installation of Epoxy Sinks: Use laboratory casework manufacturer's recommended adjustable support system for table- and cabinet-type installations. Set the top edge of sink unit in sink and countertop manufacturers' recommended chemical-resistant sealing compound or adhesive, and firmly secure to produce a tight and fully leakproof joint. Adjust sink and securely support to prevent movement. Remove excess sealant or adhesive while still wet and finish joint for neat appearance.

D. Drop-in Installation of Epoxy Cup Sinks: Rout groove in countertop to receive sink rim if not shop prepared. Set sink in adhesive and fill remainder of groove with sealant or adhesive. Use procedures and products recommended by sink and countertop manufacturers. Remove excess adhesive and sealant while still wet and finish joint for neat appearance.

E. Surface Installation of Epoxy Cup Sinks: Set sink in sealant or adhesive. Use procedures and products recommended by sink and countertop manufacturers. Remove excess sealant or adhesive while still wet and finish joint for neat appearance.

3.04 INSTALLATION OF LABORATORY ACCESSORIES

A. Install accessories according to Shop Drawings, installation requirements in SEFA 2, and manufacturer's written instructions.

B. Securely fasten adjustable shelving supports, stainless-steel shelves, and pegboards to partition framing, wood blocking, or reinforcements in partitions.

C. Install shelf standards plumb and at heights to align shelf brackets for level shelves. Install shelving level and straight, closely fitted to other work where indicated.

D. Securely fasten pegboards to partition framing, wood blocking, or reinforcements in partitions.

3.05 INSTALLATION OF SERVICE FITTINGS

A. Comply with requirements in other Sections for installing water and laboratory gas service fittings and electrical devices.

B. Install fittings according to Shop Drawings, installation requirements in SEFA 2, and manufacturer's written instructions. Set bases and flanges of sink- and countertop-mounted fittings in sealant recommended by manufacturer of sink or countertop material. Securely anchor fittings to laboratory casework unless otherwise indicated.

3.06 CLEANING AND PROTECTING

A. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

B. Protect countertop surfaces during construction with 6-mil (0.15-mm) plastic or other suitable water-resistant covering. Tape to underside of countertop at a minimum of 48 inches (1200 mm) o.c.

END OF SECTION

SECTION 12 36 61.16
SOLID SURFACING COUNTERTOPS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Solid surface material countertops.
   2. Solid surface material backsplashes.
   3. Solid surface material end splashes.
   4. Solid surface material apron fronts.

1.02 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
   1. Show locations and details of joints.
   2. Show direction of directional pattern, if any.

C. Samples for Verification: For the following products:
   1. Countertop material, 6 inches (150 mm) square.

1.03 CLOSEOUT SUBMITTALS

A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.04 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of countertops.

C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.
   1. Build mockup of typical countertop 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.

1.05 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.06 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 PRODUCTS

2.01 SOLID SURFACE COUNTERTOP MATERIALS

A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. E. I. du Pont de Nemours and Company.
      b. Formica Corporation.
      c. LG Chemical, Ltd.
      d. Wilsonart.
   2. Substitutions: Provide in accordance with Section 012500 “Substitution Procedures.”

3. Type: Provide Standard type unless Special Purpose type is indicated.
4. Colors and Patterns: As scheduled.

B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

C. Wire-Management Grommets: Circular, molded-plastic grommets and matching plastic caps with slot for wire passage.
1. Products: Subject to compliance with requirements, provide the following:
a. Doug Mockett & Company, Inc.: TG Flip-Top Series.
2. Substitutions: Provide in accordance with Section 012500 “Substitution Procedures.”
3. Outside Diameter: 2 inches (51-mm).
4. Color: As selected by Architect from Manufacturer’s full range.

D. Countertop Support Brackets: Steel, 18 inches by 24 inches, minimum 1,000 lb. load limit, factory-applied primer for field painting in accordance with Section 099123 "Interior Painting."

2.02 COUNTERTOP FABRICATION

A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."
1. Grade: Custom.

B. Countertops: 1/2-inch- (12.7-mm-) thick, solid surface material.

C. Backsplashes: 1/2-inch- (12.7-mm-) thick, solid surface material with wood-trimmed edges.

D. Fabricate tops with shop-applied edges 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.

E. Joints: Fabricate countertops without joints.

F. Cutouts and Holes:
1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch (5 mm) into fixture opening.
2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.03 INSTALLATION MATERIALS

A. Adhesive: Product recommended by solid surface material manufacturer.

B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.

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

3.02 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet (3 mm in 2.4 m), 1/4 inch (6 mm) maximum. Do not exceed 1/64-inch (0.4-mm) difference between planes of adjacent units.

B. Fasten sub tops to cabinets by screwing through sub tops into corner blocks of base cabinets. Shim as needed to align sub tops in a level plane.

C. Secure countertops to sub tops with adhesive according to solid surface material manufacturer's written instructions. 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.

D. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.

E. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.

F. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

G. Seal edges of cutouts in particleboard sub tops by saturating with varnish.

H. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION

SECTION 22 00 10
BASIC PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS AND SUPPLEMENTAL GENERAL PROVISIONS

A. The "General Conditions" and "Supplementary Conditions" are by reference made a part of this section and shall apply to each and every heading as though included herein.

B. In the event of conflict, the requirements of the "General Conditions" and "Supplementary Conditions" will take precedence over these "General Requirements".

1.2 GENERAL

A. The Contractor shall provide all plans, labor, equipment, appliances and materials, and shall perform all operations in connection with the installation of the plumbing work in accordance with the Specifications, applicable drawings, and the conditions specified above.

B. Contractor shall provide all equipment required and usually furnished in connection with such work and systems whether or not specifically mentioned or specifically indicated on the drawings.

C. Per the 2021 IECC the Mechanical System and Service Hot Water System Commissioning is not required when cooling equipment capacity is less than 480,000 Btuh (40 Tons) and the combined Space Heating and Service Hot Water System heating capacity is less than 600,000 Btuh (50 Tons).

1.3 COMMISSIONING

A. The Contractor shall provide all system commissioning services as required by section C408 of the applicable edition of the International Energy Conservation Code (IECC). Plumbing systems shall comply with IECC section C403.

B. Commissioning, as outlined in IECC section C408 shall include the following:

1. A commissioning plan.
2. Water heater(s).
3. Hot water systems balancing.
4. Functional performance testing for all plumbing equipment and controls.
5. A preliminary commissioning report.
6. Final documentation including drawings, O&M manual(s), T&B report, and final commissioning report.

1.4 INSPECTION OF THE SITE

A. The Contractor shall visit the site, verifying all existing items indicated on drawings and/or specified, and familiarize theirself with the existing work conditions, hazards, grades, actual formations, soil conditions, and local requirements. The submission of bids shall be deemed evidence of such visits.

B. All proposals shall take these existing conditions into consideration, and the lack of specific information on the drawings shall not relieve the Contractor of any responsibility.

C. The trade furnishing the equipment shall be responsible for notifying the Contractor prior to ordering it, in the event that equipment specified and/or reviewed is incompatible with this requirement.

1.5 PERMITS, UTILITY CONNECTIONS, AND INSPECTIONS

A. Refer to other sections of the specifications for construction phasing and time increments.

B. The Contractor shall obtain and pay for all required utility connections, impact fees, utility extensions and/or relocations and shall pay all costs and inspection fees for all work included herein.

1.6 APPLICABLE CODES AND STANDARDS

A. The installation shall meet the minimum standards prescribed in the latest editions of the following listed codes and standards, which are made a part of the Specifications, except as may be hereinafter modified in these Specifications and associated drawings.

B. Latest edition of the National Fire Protection Association Standards (NFPA):

1. NFPA No. 70 National Electrical Code
2. NFPA No. 101 Safety to Life from Fire in Buildings and Structures
3. NFPA No. 255 Test of Surface Burning Characteristics of Building Materials

C. United States of America Standards Institute (ASA) Standards:

1. A40.8 National Plumbing Code
2. B31.1 & B31.1a Code for Pressure Piping

D. American Society of Mechanical Engineers (ASME): Boiler and Pressure Vessel Codes.

E. American Society of Testing and Material (ASTM): All applicable manuals and standards.

F. American Water Works Association (AWWA): All applicable manuals and standards.

G. National Electrical Manufacturer's Association (NEMA): All applicable manuals and standards.

H. City and State Building Codes.

I. State of Texas Occupational Safety Act: Applicable safety standards.

J. Occupational Safety and Health Act (OSHA).

K. State of Texas Energy Conservation Construction Code.

L. All work shall be in accordance with all regulations and requirements of the State of Texas Architectural Barriers Act (TAS).

M. Refer to Specifications sections hereinafter bound for additional codes and standards.

N. All materials and workmanship shall comply with all applicable state and national codes, specifications, and industry standards. All material shall be listed by the Underwriter's Laboratories, Inc., as conforming to its standards and so labeled in every case where such a standard has been established for the particular type of material in question.

O. All equipment provided and all installation methods shall meet all applicable requirements of the International Energy Conservation Code.

P. The Contract Documents are intended to comply with the aforementioned rules and regulations; however, some discrepancies may occur. Where such discrepancies occur, the Contractor shall immediately apply for an interpretation. Should the discovery and notification occur after the execution of a contract, any additional work required for compliance with said regulations shall be paid for as covered by other specifications of the Contract Documents, providing no work or fabrication of materials has been accomplished in a manner of non-compliance. Should the Contractor fabricate and/or install materials and/or workmanship in such a manner that does not comply with the applicable codes, rules and regulations, the Contractor who performed such work shall bear all costs arising in correcting these deficiencies to comply with said rules and regulations.

1.7 CONTRACT DOCUMENTS

A. These specifications are accompanied by drawings of the building and details of the installations indicating the locations of equipment, piping, ductwork, outlets, switch controls, circuits, lines, etc. The drawings and these specifications are complementary to each other, and what is required by one shall be as binding as if required by both.

B. If the Contractor deems any departures from the drawings necessary, details of such departures and the reasons therefore shall be submitted to the Architect for review. No departures shall be made without prior written acceptance.

C. There are intricacies of construction that are impractical to specify or indicate in detail; however, in such cases the current rules of good practice and applicable specifications shall govern.

D. It is the Contractor's responsibility to properly use all information found on the Civil, Architectural, Structural, Fire Protection, Plumbing, Mechanical and Electrical drawings where such information affects their work.

E. All dimensional information related to new structures should be taken from the appropriate drawings. All dimensional information related to existing facilities shall be taken from actual measurements made by the Contractor on the site.

F. The interrelation of the specifications, the drawings, and the schedules is as follows: The specifications determine the nature and setting of the several materials, the drawings establish the quantities, dimensions and details, and the schedules give the performance characteristics.

G. Should the drawings or specifications disagree within themselves, or with each other, the better quality of greater quantity of work or materials shall be estimated upon, and unless otherwise directed by the Architect in writing, shall be performed or furnished. Figures indicated on drawings govern scale measurements and large-scale details govern small-scale drawings.

1.8 SPACE AND EQUIPMENT ARRANGEMENT

A. The size of fire protection, plumbing, 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. Shop drawings shall be prepared to indicate a suitable arrangement.

B. 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.

C. Maintain all Code required clearances for equipment access.

1.9 FABRICATION DRAWINGS

A. Contractor shall submit piping shop drawings for review by the Architect. Fabrication drawings shall be fully coordinated with ALL other trades and with existing conditions.

B. All required shop drawings, except as hereinafter specified, shall be prepared at a scale of not less than 1/8 in. equal to 1 ft. for floor plans and 1/4 in. equal to 1 ft. for mechanical rooms.

1.10 SUPERVISION

A. Each contractor shall keep a competent superintendent or foreman on the job at all times necessary for the timely and proper completion of the work.

B. It shall be the responsibility of each superintendent to study all drawings and familiarize themselves with the work to be done by other trades. They shall coordinate this work with other trades, and before material is fabricated or installed, make sure that their work will not cause an interference that cannot be resolved without major changes to the drawings. If a conflict between trades arises that cannot be resolved at the jobsite, the matter shall be referred to the Architect for their ruling.

1.11 EXISTING FACILITIES

A. The Contractor shall be responsible for loss or damage to the existing facilities caused by themself and their workmen, and shall be responsible for repairing or replacing such loss or damage. The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection and in-service maintenance of all plumbing, heating, air conditioning, and ventilating services for the new and existing facilities. The Contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, and remove all such temporary protection upon completion of the work. All barricades and safety devices shall be in compliance with OSHA.

B. The Contractor shall provide temporary or new services to all existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.

C. Where existing construction is removed to provide working and extension access to existing utilities, Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air conditioning ductwork and equipment, etc., to provide this access and shall reinstall same upon completion of work in the areas affected.

D. Where partitions, walls, floors, or ceilings of existing construction are indicated to be removed, all Contractors shall remove and reinstall, in locations approved by the Architect, all devices required for the operation of the various systems installed in the existing construction. This is to include, but is not limited to, temperature control system devices, electrical switches, relays, fixtures, piping, conduit, etc.

E. Outages of services, as required by the new installation, will be permitted only at a time approved by the Architect.

1.12 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. 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.

B. All items that 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. 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 and sealed, capped, or otherwise tied-off or disconnected in a safe manner acceptable to the Architect. 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 of facilities, which must remain in operation during the construction period, shall not be interrupted without prior specific approval of the Architect as hereinbefore specified.

D. All equipment and materials indicated to be removed and not be re-used shall be disposed of by the Contractor. Coordinate with Owner where materials are to be stored.

1.13 OPERATING AND MAINTENANCE INSTRUCTIONS

A. The Contractor shall prepare, in triplicate for the Owner's Manual, complete sets of operating and maintenance instructions, system piping, valving, control and interlock diagrams, manuals, parts lists, etc., for each item of equipment. Include copies of all equipment warranties.

B. In addition, the Contractor shall provide the services of a competent engineer or a technician acceptable to the Architect to instruct a representative of the Owner in the complete and detailed operation of all equipment and systems. These instructions shall be provided for a period of not less than 4 hours to fully accomplish the desired results. Upon completion of these instructions, a letter of release will be required, stating the dates of instruction and the personnel to whom instructions were given. The Contractor shall be responsible for proper maintenance until the instructions have been given to the Owner's maintenance personnel.

1.14 GUARANTEE

A. All work and equipment shall be guaranteed for a period of one year from the date of substantial completion.

B. Guarantee shall be for all labor and materials.

C. Certain items for equipment shall have additional or extended warranties when so specified.

1.15 MATERIALS AND WORKMANSHIP

A. All materials, unless otherwise specified, shall be of current U.S. manufacture, new, free from all defects, and of the best quality of their respective kinds. Materials and equipment shall be installed in accordance with the manufacturer's recommendations and the best standard practice for the type of work involved. All work shall be executed by mechanics skilled in their respective trades, and the installations shall present a neat, workmanlike appearance. Materials, and/or equipment damaged in shipment, or otherwise damaged prior to installation, shall not be repaired at the job site, but shall be replaced with new materials and/or equipment.

B. The responsibility for furnishing the proper equipment and/or material, and to see that it is installed as intended by the manufacturer rests entirely upon the Contractor, who shall request advice and supervisory assistance from the representative of specific manufacturers during the installation.

1.16 FLAME SPREAD PROPERTIES OF MATERIALS

A. Materials and adhesives incorporated in this project shall conform to NFPA 255, latest edition. The classification shall not exceed No. 2, with the range of indices between 0 to 25 for these Classifications as listed in the Federal Specifications. Modifications shall be made to insulating materials, etc., as required to comply with the Federal Specification.

1.17 LARGE APPARATUS

A. Any large piece of apparatus which is to be installed in any space in the building, and which is too large to permit access through stairways, doorways, or shafts shall be brought to the job and placed in the space before the enclosing structure is completed. Following placement in the space, such apparatus shall be thoroughly, completely protected from damage as hereinafter specified.

1.18 FLOOR AND CEILING PLATES

A. Except as otherwise noted, provide chrome plated brass floor and ceiling plates around all pipes, conduits, ducts, etc., passing exposed through walls, floors, or ceilings, in any spaces, except under floor and attic spaces. Plates shall be sized to fit snugly against the outside of the pipe or against the insulation on lines that are insulated and positively secured to such pipe or insulation. Plates will not be required for piping where pipe sleeves extend 3/4 in. above finished floor. All equipment rooms are classified as finished areas. Round and rectangular ducts shall have plates made to fit accurately at all floor, wall and ceiling penetrations.

1.19 SLEEVES, INSERTS AND FASTENINGS

A. Proper openings through floors, walls, roofs, etc., for the passage of piping, ductwork, etc., shall be provided. All penetrations must pass through sleeves except soil pipe installed under concrete slabs on fill. Sleeves shall be set in new construction before concrete is poured, as cutting holes through any part of the concrete will not be permitted unless acceptable to the Architect.

B. Pipes passing through concrete or cinder walls and floor or other corrosive material shall be protected by a protective sheathing or wrapping or by sleeves, as required to meet the local code. Annular spaces between sleeves and pipes shall be filled or tightly caulked in an approved manner. Annular spaces between sleeves and pipes in fire-resistance-rated assemblies shall be filled or tightly caulked in accordance with the local code.

C. The minimum clearance between horizontal penetrations including insulation where applicable, and sleeves shall be 1/4 in., except that the minimum clearance shall be 2 in. where piping contacts the ground. Sleeves through walls and partitions shall be installed flush with exposed surfaces. Sleeves through floors shall be extended 2 in. above finished floor.

D. Above grade and dry location sleeves shall be constructed from 20 to 22 gauge galvanized steel. Sleeves passing through walls or floors on or below grade and/or moist areas such as mechanical rooms shall be constructed of galvanized steel Schedule 40 pipe and shall be designed with suitable flange in the center of the floor or wall to form a waterproof passage. After the pipes have been installed in the sleeves, void space around the pipe shall be sealed with "Link-Seal" modular wall and casing seals as manufactured by Thunderline Corporation.

E. Suitable concrete inserts for pipe and equipment hangers shall be set and properly located for all pipe and equipment to be suspended from concrete construction.

F. Fastening of pipes, conduits, etc., in the building shall be as follows: To wood members - by wood screws; to masonry - by threaded metal inserts, metal expansion screws, or toggle bolts, whichever is appropriate for the particular type of masonry; to steel - machine screws or welding (when specifically permitted or directed), or bolts, and to concrete by suitable inserts anchored to reinforcing steel, and poured in place unless other means are acceptable for general use, and will only be permitted where specifically acceptable to the Architect.

G. Under no circumstances will the use of plastic anchors or plastic expansion shields be permitted for any purpose whatsoever.

H. Vermin Proofing: The open space around all ductwork, piping, etc., passing through the ground floor and/or exterior walls shall be sealed with a continuous bead of sealant.

I. The space around piping, ductwork, etc., penetrating walls, ceilings and floors that define air plenums shall be sealed airtight in an acceptable manner. Ceiling plenums used for return air are considered air plenums.

1.20 ACCESS DOORS

A. This Contractor shall provide wall or ceiling access doors for unrestricted access to all concealed shutoff or service valves, strainers, unions, flow switches, pressure reducing valves, control valves, air terminal units, fire and/or smoke dampers, and other items of concealed mechanical equipment. All access door locations are not shown on the drawings. It is the Contractor's responsibility to provide access doors at all locations required.

B. Access doors mounted in painted surfaces shall be equal to Milcor (Inland-Ryerson Construction Products Company) manufacture, 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 minimum of 18 in. x 18 in. in size.

1.21 CONSTRUCTION REQUIREMENTS

A. The Civil, Architectural, Structural, Fire Protection, Mechanical, Plumbing, and Electrical plans and specifications including the General Provisions, Supplemental General Provisions, and other pertinent documents issued by the Architect, are a part of these specifications and the accompanying fire protection drawings, and shall be complied with in every respect. All the above is included in the Contract Documents, and shall be examined by all bidders. Failure to comply shall not relieve the Contractor of responsibility or be used as a basis for additional compensation due to omission of architectural, structural and electrical details from the plumbing drawings.

B. It is the intent of the Contract Documents to provide an installation complete in every respect. In the event that additional details or special construction may be required for work indicated or specified in this section or work specified in other sections, it shall be the responsibility of the Contractor to provide same as well as to provide material and equipment usually furnished with such systems or required to complete the installation, whether mentioned or not.

C. The Contractor shall be responsible for fitting their material and apparatus into the building and shall carefully lay out their work at the site to conform to the structural conditions, to avoid all obstructions, to conform to the details of the installation supplied by the manufacturer of the equipment to be installed and thereby to provide an integrated satisfactory operating installation.

D. The plumbing and associated drawings are necessarily diagrammatic in character and cannot show every connection in detail or every pipe or equipment in its exact location. These details are subject to the requirements of ordinances and also 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 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. Work shall be installed to avoid crippling of structural members; therefore, inserts to accommodate pipe hangers shall be set before concrete is poured, and proper openings through floor, walls, beams, etc., shall be provided as hereinafter specified or as otherwise indicated or required. All work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.

E. When the plumbing drawings do not give exact details as to the elevation of pipe, ducts, etc., physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Piping and 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, and the plans do not show all required offsets, control lines, pilot lines and other location details. Work shall be concealed in all finished areas. Piping specified to be insulated shall be supported in a manner that will allow the insulation to be installed without gaps. Insulated piping in concealed areas shall be offset with fittings as necessary to permit installation of insulation. Bending of pipes or installing pipes in a strain in order to insulate will not be permitted.

F. All oiling devices and all parts of equipment requiring adjustment shall be easily accessible. Equipment shall be so located and installed as to permit convenient and safe maintenance and future replacement. Piping, ductwork, valve stems, etc., shall not block service space.

1.22 PLUMBING SUBMITTALS AND SHOP DRAWINGS

A. Definitions:

1. Submittal - Equipment, Product Data, and Material Information for components proposed to be installed for the project.
2. Shop Drawing - Scaled floor plans, riser or isometric diagrams, and elevations of proposed component

B. Refer to the Conditions of the Contract (General and Supplementary) and Division 01 Section: "SUBMITTALS" for submittal definitions, requirements, and procedures.

C. Submittal and Shop Drawings will be accepted only when submitted by the Contractor. Data submitted from Subcontractors and material suppliers directly to the Architect will not be processed.

D. Submit Submittals, product data, and samples on items indicated in the individual sections.

E. Submittals and Shop Drawings shall not be used as requests or proposals for alternate equipment or materials. Refer to Item "Product Options and Substitutions" elsewhere in this section.

F. THIRD PARTY CERTIFICATION: All Packaged equipment shall be independently Third Party labeled as a system for its intended use by a Nationally Recognized Testing Laboratory (NRTL) in accordance with OSHA Federal Regulations 29CFR1910.303 and .399, as well as NFPA Pamphlet #70, National Electric Code (NEC), Article 90-7.

1.23 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Refer to the Instructions to Bidders and the Division 01 Section "SUBSTITUTION PROCEDURES" for requirements in selecting products and requesting substitutions.

B. Standards for Materials:

1. These specifications indicate a standard for all materials incorporated into the work, with manufacturer's names and catalog numbers used to establish a grade and quality of materials and equipment. The manufacturer listed on the equipment schedules, or named first in the specifications, is the one on whose equipment the layout is based. Other named manufacturers must meet the indicated performance and space requirements.

2. The "approved equal" clause used in these specifications is to permit the proposal of unnamed manufacturer's products for the work, and the Architect/Engineer's decision concerning equal products is final.
3. Considerations as to determination of equal products include, but are not limited to, the following:

Materials	Physical size
Workmanship	Weight
Gauges of Materials	Appearance
Available Local Service Personnel	Performance
Previous successful installations	Capacity
Delivery Schedules	Required Equipment Clearances

4. [Shop Drawings must be submitted if proposed equipment differs in physical size than specified equipment to indicate proposed equipment has been coordinated with other trades and space allocated for this equipment. Shop drawings must be at a 1/4" per foot scale indicating proposed equipment layout and any other equipment/materials noted in that general area. Other equipment may include, but is not limited to, HVAC equipment, plumbing equipment, electrical equipment, light fixtures, structural members, cabinetry, etc.]
5. Failure to submit scaled Shop Drawings will indicate that the Contractor has coordinated their effors with other trades and finds no conflicts with the work presented in the Contract Documents.

C. Requests for substitutions for equipment, materials and apparatus listed in Division 22 Sections must be submitted in writing a **MINIMUM OF 10 DAYS** prior to the scheduled bid date. Such requests must be accompanied by complete data to permit proper evaluation.

D. BIDS SHALL NOT BE BASED ON UN-APPROVED MATERIALS, EQUIPMENT, OR APPARATUS. UNAPPROVED MATERIAL, EQUIPMENT OR APPARATUS WILL NOT BE ACCEPTED.

E. Should electrical, water, drain, natural gas, structural support, or other similar requirements for alternate equipment, whether named in the specifications or approved as a substitution, be different from requirements for the products used in laying out the project, such changes shall be the responsibility of the Contractor, and shall not result in extra charges to the Owner or Architect/Engineer.

1.24 RECORD DOCUMENTS

A. Refer to the Division 01 Section: "CLOSEOUT PROCEDURES" for requirements. The following paragraphs supplement the requirements of Division 01.

B. Mark Drawings to indicate revisions to piping and ductwork, size and location both exterior and interior; including locations of coils, dampers and other control devices, filters, boxes, and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned for column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.); Change Orders; concealed control system devices.

C. Mark Specifications to indicate approved substitutions; Change Orders; actual equipment and materials used.

1.25 PAINTING

A. Field painting of plumbing equipment, piping systems, etc., shall be accomplished under Division 09 of these specifications.

B. Protection of Factory-applied Finishes:

1. Factory-applied finishes on equipment and apparatus installed on the project shall be carefully protected.

2. At the conclusion of the work, and prior to final acceptance of the project, equipment and apparatus shall be thoroughly cleaned of all construction dirt, oil and grease smears, temporary labels, debris, paint droppings, etc.

3. Damaged factory finishes shall be restored to their original condition using procedures, materials and application techniques as set forth in Division 09 found elsewhere in these specifications.

1.26 CLEANING

A. Refer to the Division 01 Section: "CLOSEOUT PROCEDURES" for general requirements for final cleaning.

B. Refer to Division 23 Section: "MECHANICAL TESTING, ADJUSTING AND BALANCING" for requirements for cleaning filters, strainers, and mechanical systems prior to final acceptance.

C. Name Plates:

1. All nameplates shall be protected from damage during the construction process.

2. At the conclusion of the work, the nameplates shall be carefully cleaned and left in a fully legible condition.

D. Removal of Rubbish: Each Contractor is responsible for the timely removal of rubbish and trash generated by their work, such as empty cartons, containers, materials crates, etc. Particular attention is called to residue that may present a potential tripping or injury hazard.

1.27 MOTORS AND DRIVES

A. Motors:

1. General: Motors shall be U/L-approved, with copper windings, and with a minimum Service Factor of 1.15. The nominal capacity shall exceed the brake horse-power requirements at duty schedules.

2. Motors 1/2 HP and smaller shall be 120-volt, single-phase with internal overload protection.

3. Motors 3/4 HP and larger shall be 208/230 or 460-volt, 3-phase, unless scheduled or noted otherwise, and shall have thermal over-load cutouts in each phase as recommended by the motor manufacturer.

4. Motors shall be as manufactured by Century, General Electric, US Motors, Wagner, Westinghouse, or approved equal.

B. Drives:

1. Belts drives shall be rated for 150% of motor-rated horsepower.
2. Drive assemblies up to two (2) belts shall have adjustable motor sheaves with the mid-point of the adjustment range at the RPM required for the specified performance.
3. On drive assemblies with 3 or more belts, provide fixed motor sheaves for the specified RPM. Provide and install up to 2 pulley changes as necessary to achieve the required air quantities.
4. All multiple-belt drives shall be factory-marked-matched sets.

C. Specific requirements:

1. Provide high-efficiency motors for the following:
   a. Pumps, as scheduled.
2. Efficiency ranges shall be as follows:

Nominal HP	Minimum Efficiency	Premium Efficiency
3	86.5	89.5
5	87.5	89.5
7.5	88.5	91.7
10	89.5	91.7
15	91.0	92.4
20	91.0	93.0
25	91.7	93.6
30	92.4	93.6
40	93.0	94.1
50, 60, 75	93.0, 93.6, 94.1	94.5, 95.0, 95.4
100	94.1	95.4

3. Motor efficiency certification shall be included with Product Submittal Data in accordance with Division 01 of these specifications.
4. Variable Speed (Frequency) AC Drives:
   a. Where scheduled on the plans, provide and install variable speed (frequency) AC drives for motors.
   b. Variable speed (frequency) AC drives shall be as described in Section 23 89 65 - MOTOR CONTROLLERS - of these Specifications.
5. Motor Starters and Controllers:
   a. Motor starters and controllers for fans, pumps, air-handling units, compressors, etc., which are not provided as an integral part of a factory-assembled package, shall be provided under Division 23 of the specifications. Refer to Section 23 89 65 - MOTOR CONTROLLERS.

PART 2 - PRODUCTS

2.1 GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS

A. The manufacturer's published instructions shall be followed for preparing, assembling, installing, erecting, and cleaning manufacturer's materials or equipment, unless otherwise indicated. 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's 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.

B. The Contractor shall not receive material or equipment at the jobsite until there is suitable space provided to properly protect equipment from rust, drip, humidity, and dust damage.

C. Capacities shall be not less than those indicated but shall be such that no component or system becomes inoperative or is damaged because of start-up or other overload conditions.

D. Where materials or equipment are specified to be approved, listed, tested, or labeled by the Underwriter's Laboratories, Inc., or constructed and/or tested in accordance with the standards of the American Society of Mechanical Engineers, the Contractor shall submit proof that the items furnished under these sections of the specifications conform to such requirements. The ASME stamp will be acceptable as sufficient evidence that the items conform to the respective requirements.

E. Each major component of equipment shall have the manufacturer's name, address, and catalog number on a plate securely attached to the item of equipment. All data on nameplates shall be legible at the time of Final Observation.

F. Standard factory finish will be acceptable on equipment specified by model number; otherwise surfaces of ferrous metal shall be given a rust-inhibiting coating. The treatment shall withstand 200 hours in salt-spray fog test, in accordance with Method 6061 of Federal Standard No. 141. Immediately after completion of the test, the specimen shall show no signs of wrinkling or cracking, and no signs of rust creepage beyond 1/8 in. on either side of the scratch mark. Where rust-inhibitor coating is specified hereinafter, any treatment that will pass the above test is acceptable, unless a specific coating is specified, except that coal tar or asphalt type coatings will not be acceptable, unless so stated for a specific item. Where steel is specified to be hot-dip galvanized, mill-galvanized sheet steel may be used provided all raw edges are painted with a zinc-pigmented paint conforming to Military Specification MIL-P-6215.

G. Belts, pulleys, chains, gears, couplings, projecting setscrews, keys and other rotating parts located so that any person can come in close proximity thereto, shall be fully enclosed or properly guarded.

H. The Contractor shall be responsible for the coordination and proper relation of their work to the building structure and to the work of all trades. The Contractor shall visit the premises and thoroughly familiarize themself with all details of the work and working conditions, to verify all dimensions in the field, and to advise the Architect of any discrepancy before performing any work. Adjustments to the work required, in order to facilitate a coordinated installation, shall be made at no additional cost to the Owner.

2.2 PROTECTION

A. 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. Failure on the part of the Contractor to comply with the above will be sufficient cause for the rejection of the items in question.

B. Take particular care not to damage the building structure in performing work. All finished floors, steel treads, and workmen or their tools and equipment shall cover finished surfaces to prevent any damage during the construction of the building.

C. 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 observation must be cleaned of rust and repainted as specified elsewhere in these specifications.

2.3 COOPERATION BETWEEN TRADES AND WITH OTHER CONTRACTORS

A. Each trade, subcontractor and/or contractor must work in harmony with the various other trades, subcontractors, and/or contractors on the job as may be required to facilitate the progress to the best advantage of the job as a whole. Each trade, subcontractor, and/or contractor must pursue their work promptly and carefully as not to delay the general progress of the job. This Contractor shall work in harmony with contractors working under other contracts on the premises.

2.4 PRECEDENCE OF MATERIALS

A. These specifications and the accompanying drawings are intended to cover systems which will not interfere with the structural design of the building, which will fit into the available space, and which will insure complete and satisfactory systems. Each Contractor shall be responsible for the proper fitting of thier material and apparatus into the building.

B. Each Contractor shall so harmonize their work with that of the other trades so that it may be installed in the most direct and workmanlike manner without hindering or handicapping the other trades. Piping interferences shall be handled by giving precedence to pipelines that require a stated grade for proper operation. Where space requirements conflict, the following order of precedence shall, in general, be observed: See special conditions noted hereinafter for work integrated with structural systems.

1. Building lines
2. Structural members
3. Drain piping
4. Vent piping
5. Condensate piping
6. Refrigerant piping
7. Electrical bus duct
8. Supply ductwork

9. Return ductwork
10. Exhaust ductwork
11. Chilled water and heating water piping
12. Automatic Fire Protection Sprinkler Piping
13. Natural gas piping
14. Domestic hot and cold water piping
15. Electrical conduit

2.5 LOCATION OF OUTLETS IN ROOMS

A. All fire protection, plumbing, acoustical tile, diffusers, grilles, registers, and other devices shall be referenced to coordinated, established data points and shall be located to present symmetrical arrangements with these points and to facilitate the proper arrangements of acoustical tile panels and other similar panels with respect to the mechanical and electrical outlets and devices. Those mechanical and electrical outlets shall be referenced to such features as wall and ceiling furrings, balanced border widths, masonry joints, etc. Outlets in acoustical tile shall occur symmetrically in tile joints or in the center of whole tiles. When locations of mechanical and electrical devices shown on the Architect's reflected ceiling plans need to be modified, 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 diagrammatically the location of the various outlets and apparatus. Exact locations of these outlets and apparatus shall be determined by reference to the general 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 apparatus before installation, without additional cost to the Owner.

C. The Contractor, by submitting a bid on this work, sets forth that he has the necessary technical training and ability, and that he will install their work in a satisfactory and workmanlike manner which is up to the best standards of the trade, complete, and in good working order. If any of the requirements of the drawings and specifications are impossible of performance, or if the installation, when made in accordance with such requirements, will not perform satisfactorily, he shall report it to the Architect for correction promptly after discovery of the discrepancy.

2.6 CONNECTIONS FOR OTHERS

A. This Contractor shall rough-in for and make all gas, water, steam, sewer, etc., connections to all fixtures, equipment, machinery, etc., provided by others in accordance with detailed roughing-in drawings provided by the equipment suppliers, along with 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 where required. In each water line serving an item of equipment or piece of machinery, provide a shut-off 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.

2.7 WALL HUNG CARRIERS

A. Provide floor mounted carriers for all wall mounted fixtures. Refer to Architectural plans and confirm walls intended to conceal carriers are adequate in depth to provide necessary space and clearance to properly install the carriers.

PART 3 - INSTALLATION

3.1 INSTALLATION METHODS

A. All pipes shall be concealed in pipe chases, walls, furred spaces, or above the ceiling, unless otherwise indicated.

B. Piping may be run exposed in mechanical rooms, janitors' closets, or storage spaces, but only where necessary. All exposed piping shall be run in the neatest, most inconspicuous manner, and parallel or perpendicular to the building lines.

C. All piping shall be adequately and properly supported from the building structure by means of hanger rods or clamps to walls as herein specified.

D. Where limited space is available above the ceilings and below concrete beams or other deep projections, pipe and conduit shall be sleeved through the projection where it crosses, in a manner to provide maximum above-floor clearance. Sleeves shall be as specified or as required.

E. All pipe, conduits, etc., shall be cut accurately to measurements established at the building and shall be worked into place without springing or forcing. All ducts, pipes and conduits run, exposed in machinery and equipment rooms, shall be installed parallel to the building plans, except as otherwise shown. Conduits in furred ceilings and in other concealed spaces may be run at angles to the construction but shall be neatly grouped and racked indicating good workmanship. All conduit and pipe openings shall be kept closed until the systems are closed with final connections.

F. There shall be no pipe joints nearer than 12 in. to a wall, ceiling, or floor penetration, unless pipe joint is the welded type joint.

G. The Contractor shall study all construction documents and carefully lay out all work in advance of fabrication and erection in order to meet the requirements of the extremely limited spaces. Where conflicts occur, the Contractor shall meet with all involved trades and the Architect and resolve the conflict, prior to erection of any work, in the area involved.

3.2 CUTTING AND PATCHING

A. Cut and patch openings through walls, floors, etc., resulting from work in existing construction or by failure to provide proper openings or recesses in new construction.

B. Openings cut through concrete and masonry shall be made with masonry saws and/or core drills at locations acceptable to the Architect. Impact-type equipment will not be used, except where specifically acceptable to the Architect. Openings in Precast concrete slabs for pipes, conduits, outlet boxes, etc., shall be core drilled or cast to exact size.

C. All openings shall be restored to "as-new" condition under the appropriate Specification Section for the materials involved, and shall match remaining surrounding materials and/or finishes.

D. 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.

E. All plumbing work in areas containing plaster shall be completed prior to the application of the finish plaster coat. Cutting of finish plaster coat will not be permitted.

F. No cutting, boring, or excavating, which will weaken the structure, shall be undertaken. NO STRUCTURAL MEMBER MAY BE CUT WITHOUT THE WRITTEN APPROVAL OF THE ARCHITECT, ENGINEER, and OWNER'S REPRESENTATIVE.

3.3 ROOF PENETRATIONS

A. Pipe and duct sleeves and flashings compatible with the roofing installation shall be provided for roof penetrations. Manufacturer of roofing materials shall approve methods and materials.

1. Pitch pans are not acceptable.

B. Roof penetrations through metal roofs by the Plumbing or Mechanical Contractor will be required to have written approval by the Roofing Contractor.

C. Piping penetration flashings shall be specially made for metal roofs and shall be EPDM or neoprene compression molded rubber with corrosion resistant metal base. Flashings shall be by Portals Plus, Inc., Buildex Dektite, or approved equal.

3.4 FABRICATION OF PIPE

A. All the various piping systems shall be made up straight and true and run at proper grades to permit proper flow of the contained material. Lines shall also be graded for proper drainage.

B. Piping shall follow as closely as possible the routes shown on plans, but shall take into consideration conditions to be met at the site.

C. Should any unforeseen conditions arise, lines shall be changed or rerouted as required after approval has been obtained.

D. All piping shall be installed with due regard to expansion and contraction and so as to prevent excessive strain and stress in the piping, in connections, and in equipment to which lines are connected.

E. All piping shall be clean when it is installed. Before installation it shall be checked, upended, swabbed, if necessary, and all rust or dirt from storage shall be removed. Pipe shall not be permitted to lie on the ground during storage. Pipe ends shall be sealed during storage.

3.5 IDENTIFICATION AND LABELING

A. The Contractor shall make it possible for the personnel operating and maintaining the equipment and systems in this project to readily identify the various pieces of equipment, valves, piping, etc., by marking them.

B. All items of mechanical and electrical equipment shall be identified by the attachment of engraved nameplates constructed from laminated phenolic plastic, at least 1/16 in. thick, 3-ply, with black surfaces and white core. Engraving shall be condensed gothic, at least 1/2 in. high, appropriately spaced. Nomenclature on the label shall include the name of the item, its mark number, area, space, or equipment served, and other pertinent information.
Equipment to be labeled shall include, but not be limited to, the following:

1. Domestic Water Heaters
2. Circulation Pumps
3. Air Compressor
4. Motor controllers
5. Miscellaneous similar and/or related items.

C. The Contractor shall install identification tags to be affixed to those valves that have functions that are not obvious. For example, it would not be expected that valves at a pressure reducing station in a machine room would be tagged. The valve identification tags shall be brass discs, 2 in. in diameter. Each tag shall be attached to its valve with copper clad annealed iron wire or other approved material.

3.6 TESTS AND INSPECTIONS

A. The Contractor shall, during the progress of the work and upon its completion, test their work and make all tests as required by the specifications, state, municipal and other authorities having jurisdiction of the work. Piping pressure tests shall be made before pipe is concealed or covered. Tests shall be made in the presence of authorities requiring tests. The Contractor shall pay all costs, inspection charges and fees required for the tests of their work.

B. The Contractor shall provide all apparatus, temporary piping connection, etc., required for tests. The Contractor shall take all due precautions to prevent damage to the building or its contents incurred by such tests. The Contractor shall repair and make good at their own expense any damage caused by failures or leaks during the tests.

C. Leaks, defects or deficiencies shall be repaired and/or replaced, and tests shall be repeated until the test requirements are complied with fully.

D. All equipment shall be placed in operation and tested for proper automatic control before the final balancing of the system is started.

E. All tests shall have pertinent data logged by the Contractor at the time of testing. Data shall include date, time, personnel, description, and extent of system tested, test condition, test results, specified results, and any other pertinent data. Data shall be delivered to the Architect.

3.7 COOPERATION AND CLEANUP

A. It shall be the responsibility of each trade to cooperate fully with the other trades on the job to help keep the job site in a clean and safe condition. At the end of each day's work, each trade shall properly store all of their tools, equipment and materials and shall clean their debris from the job. Upon the completion of the job, each trade shall immediately remove all of their tools, equipment, any surplus materials and all debris caused by their portion of the work.

3.8 CLEANING AND PAINTING

A. All equipment, piping, ductwork, grills, insulation, etc., in finished areas furnished and installed by the Contractor shall be painted. Finished areas include mechanical rooms, boiler rooms, and outside the building as well as occupied areas inside the building. Final painting is to be done by the General Contractor. This Contractor shall thoroughly clean all part of materials and equipment of cement, plaster, and other 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 steel brushes to remove rust and other spots and left smooth and clean.

B. This Contractor shall thoroughly clean the finish on all parts of the materials and equipment with factory applied finishes. Exposed parts in equipment rooms, above crawl space slabs, and all other spaces except sealed chases and attics shall be thoroughly cleaned of cement, plaster and other materials, and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all cracks and corners scraped out. If the finish has been damaged, the Contractor shall re-paint to the satisfaction of the Architect.

C. All canvas finishes shall be painted with one sizing coat if not already sized, containing a mildew resistant additive and Arabol adhesive prior to any other specified finish paint.

D. No nameplates on equipment shall be painted, and suitable protection shall be afforded to the plates to prevent their being rendered illegible during painting operation.

3.9 ELECTRICAL PROVISIONS OF PLUMBING WORK

A. The extent of electrical provisions to be provided as plumbing work is indicated in other sections of the specifications, on the drawings and as further specified in this section.

B. Starters, Controllers: In general, plumbing includes furnishing combination starters. Controllers are specifically included as electrical work when mounted in motor control centers. Electrical work includes installation, mounting and wiring of starters and controllers that are furnished as mechanical work. Free standing, large motor controllers shall be set in place, on pads, as plumbing work.

C. Electrical heating equipment shall be furnished complete with internal or integral fusing and subdivision of loads to comply with the NEC.

D. Wherever possible, match the elements of the electrical provisions of plumbing work with similar elements of the electrical work specified in electrical sections of the specifications.

E. Standards:

1. For electrical equipment and products, comply with applicable NEMA standards, and refer to NEMA standards to definitions of terminology herein.
2. Comply with National Electrical Code (NFPA No. 70) for installation requirements.
3. Comply with National Electrical Contractors Association (NECA) "Standard of Installation".

3.10 TEMPORARY FACILITIES

A. Unless noted otherwise in the Supplementary General Conditions; provide temporary facilities.

3.11 EQUIPMENT INSTALLATION REQUIREMENTS

A. All plumbing equipment shall be furnished and installed complete and ready for use.

B. Others shall furnish certain kitchen , lab, or Owner process equipment. Contractor shall be responsible for furnishing and installing all items as required to make equipment complete operating systems. The Contractor shall furnish and install all auxiliary piping, valves, controls, control wiring, conduit, alarms, etc., required. All necessary devices, control wiring, conduit, etc., will not necessarily be shown on the drawings.

3.12 EXCAVATION, BACKFILLING AND COMPACTION

A. Excavation:

1. Excavate to the depths required or as indicated.
2. Retain suitable sandy soil for backfilling.
3. Remove excess and non-suitable material.
4. Shore as necessary.
5. Excavate all materials encountered including rock and filled-in material.
6. Form sides where required.

B. Backfilling:

1. Do not backfill until all tests are complete and approved.
2. Backfill bottom of trench in 6 in. layers using sandy fill.
3. Place pipe on minimum bed of 6 in. sand.
4. Backfill around pipe and minimum of 12 in. above pipe with sand.

C. Compaction:

1. Compact backfill to 95% maximum density for cohesionless soils.

3.13 OWNER FURNISHED EQUIPMENT

A. The Contractor’s responsibility shall include receiving and installing all Owner-furnished equipment.

END OF SECTION

SECTION 22 05 06

PLUMBING DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Demolition of:

1. Plumbing fixtures and trim, specialties, equipment and associated piping.
2. Fire protection equipment and associated piping.
3. Hanger and support devices.
4. All other appliances or devices associated with equipment or devices to be removed.

B. Demolition of all power wiring and conduit from each plumbing item to be removed back to the point of supply.

1.2 QUALITY ASSURANCE

A. Perform all demolition and removal work necessary to arrive at the arrangement shown on the Contract Drawings.

B. Perform all operations in such a method to cause minimum damage to items to be relocated, salvaged, or to remain intact and in use.

1.3 JOB CONDITIONS

A. Perform site repair and removal of salvaged items at times approved by the Owner. Accomplish repair and removal of items in a continuous and diligent manner in order to limit interference with Owner's on-going operations.

B. Drawings may not indicate and specifications may not identify every item required to be moved or removed.

C. Before submitting bids, visit and examine the site of the work and become familiar with the scope of the work and the details of the demolition work to be accomplished.

D. Submittal of a bid will be evidence that such an examination has been made and the various details noted.

E. Claims for extra compensation because of additional labor, materials, or equipment required because of difficulties encountered, will not be recognized unless items were concealed at time of inspection of the Contract Documents. Bring all such items to the attention of the Owner's Representative and the Architect for their disposition before continuing with the work.

F. Execute demolition work in a manner to protect adjacent equipment and other existing items against damage.

G. Provide and erect lights, barricades, warning signs, and other items as required for protection of the Owner's employees, building occupants, and the public.

H. Maintain barricades in good condition throughout the project to substantial completion.

I. Control the dust resulting from demolition to prevent it from spreading the occupied areas of the building and to avoid creating a nuisance in the immediate surrounding area.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 PROTECTION

A. Provide protection for all building elements, all items which are to remain, all occupants and all workers at all times, and in accordance with all requirements of the Owner.

3.2 PROTECTION OF BUILDING FROM THE WEATHER

A. Maintain weather protection for the space(s) being worked in at all times, and in accordance with all requirements of the Owner.

3.3 DEMOLITION

A. Perform demolition in accordance with all requirements of the Owner.

3.4 DISPOSITION OF MATERIALS

A. Dispose of all demolition items and materials in a legal off-site location.

3.5 RELOCATION AND REUSE OF PLUMBING ITEMS

A. Relocate items indicated on the Contract Drawings as required to accommodate the new construction. Remove, relocate and reconnect equipment and accessories that are to be reused.

B. Coordinate the work with the Electrical Contractor. Determine which items and equipment are to remain, to be relocated or to be removed. Perform the work consistent with the scope of the project.

C. Transport and store materials removed and designated for relocation as directed by the Owner's Representative.

D. Remove all salvage items not be reused or delivered to the Owner, from the property at the end of each workday.

E. Maintain full water, drain, electrical service, etc., to all equipment and apparatus that remains in service in the building.

3.6 CLEANING

A. Section 22 00 10 - BASIC PLUMBING REQUIREMENTS.

3.7 REMOVAL OF WATER

A. Be responsible for the removal of water in areas in which scheduled work is to be performed.

1. Remove water by pumping, siphoning, absorbent mopping, or compressed air brooming.
2. Do not use any method of removal that will cause damage to new or reused adjacent equipment or materials.

3.8 SCHEDULING

A. Schedule demolition in strict compliance with the Owner's instructions.

3.9 DISCONNECTION AND RECONNECTION OF UTILITIES

A. Do not disconnect or reconnect any utilities until notifying the Owner's Representative.

B. Notify the Electrical Contractor when requiring Electrical Disconnect or Reconnect.

END OF SECTION

SECTION 22 05 12

PLUMBING AND ELECTRICAL COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Refer to Section 26 05 10 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.

B. Refer to Section 21 00 10 - BASIC FIRE PROTECTION REQUIREMENTS.

C. Refer to Section 22 00 10 - BASIC PLUMBING REQUIREMENTS.

D. Refer to Section 23 00 10 - BASIC MECHANICAL REQUIREMENTS.

1.2 SUMMARY

A. This Section describes the coordination between the Fire Protection, Plumbing, Mechanical and Electrical portions of the work.

B. This Section is included under the Division 21 portion of the Specifications as Section 21 05 12, under the Division 22 portion of the Specifications as Section 22 05 12, under the Division 23 portion of the Specifications as Section 23 05 12, and under the Division 26 portion of the Specifications as Section 26 05 12.

1.3 WORK INCLUDED

A. Responsibility: Unless otherwise indicated, motors and controls shall be furnished, set in place and wired in accordance with the following schedule. **This schedule may include equipment and systems that are not required for this project. Only the equipment and systems that are required on the drawings and/or specified elsewhere will be required by this section:**

	ITEM	FURNISHED UNDER DIVISION	INSTALLED UNDER DIVISION	WIRED AND CONNECTED UNDER DIVISION
1.	Equipment Motors	21/22/23	21/22/23	26
2.	Magnetic Motor Starters			
	a. Automatically controlled, with or without HOA switches	21/22/23	26	Notes 1,3,5
	b. Automatically controlled, with or without HOA switches and furnished as part of factory wired equipment	21/22/23	22/23	Notes 1,3,5
	c. Manually controlled	21/22/23	26	Notes 1,3,5
	d. Manually controlled and furnished as part of factory wired equipment	21/22/23	26	Notes 1,3,5
	e. Furnished in Motor Control Centers	26	26	Notes 1,3,5

	ITEM	FURNISHED UNDER DIVISION	INSTALLED UNDER DIVISION	WIRED AND CONNECTED UNDER DIVISION
3.	Variable Speed (Frequency) AC Drives	22/23	26	Notes 1,4,5
4.	Line voltage thermostats, time clocks, etc., not connected to control panel systems	23	26	23
5.	Electric thermostats, time clocks, remote bulb thermostats, motorized valves, float controls, etc. which are an integral part or directly attached to ducts, pipes, etc.	22/23	22/23	22/23
6.	Temperature control panels and time switches mounted on temperature control panels	23	23	23
7.	Motorized valves, motorized dampers, solenoid valves, EP and PE switches, etc.	23	23	Note 1
8.	Alarm bells furnished with equipment installed by Division 22 or 23	22/23	22/23	22/23
9.	Wiring to obtain power for control circuits, including circuit breaker	21/22/23	21/22/23	21/22/23
10.	Low voltage controls	21/22/23	21/22/23	21/22/23
11.	Fire protection system (sprinkler) controls	21	21	Note 8
12.	Fire and smoke detectors installed on mechanical units and in ductwork	28	23	Note 8
13.	All relays required for fan shutdown, motorized dampers, smoke control devices, and other items integral with HVAC equipment to provide operation and control of HVAC equipment	23	23	Note 1

	ITEM	FURNISHED UNDER DIVISION	INSTALLED UNDER DIVISION	WIRED AND CONNECTED UNDER DIVISION
14.	Smoke dampers, and combination fire/smoke dampers	23	23	Note 7
15.	Boiler and water heater controls, boiler burner controls panels	22/23	22/23	22/23
16.	Pushbutton stations, pilot lights	22/23	22/23	22/23
17.	Heat Tape	21/22/23	21/22/23	26
18.	Disconnect switches, manual operating switches furnished as a part of the equipment	21/22/23	21/22/23	Notes 1,5
19.	Disconnect switches, manual operating switches furnished separate from equipment	26	26	26
20.	Multispeed switches	23	23	26
21.	Thermal overloads	21/22/23	21/22/23	21/22/23
22.	Control relays, transformers	21/22/23	21/22/23	21/22/23
23.	Refrigeration cycle, cooling tower and controls	23	23	23
24.	Tamper switches for fire protection (sprinkler) system	21	21	28
25.	Flow and/or pressure switches for fire protection (sprinkler) system	21	21	28
26.	Fire and jockey pump controllers and automatic transfer switch	21	21	Note 6
27.	Alarm bells or horns for fire protection (sprinkler) system	21	21	28
28.	Generator (underground) fuel tank	22	22	--
29.	Generator fuel level indicator	22	22	26
30.	Generator fuel piping from tank to generator	22	22	--

	ITEM	FURNISHED UNDER DIVISION	INSTALLED UNDER DIVISION	WIRED AND CONNECTED UNDER DIVISION
31.	Underground fuel tank leak detection and monitoring system	22	22	22

NOTES:

(1) Power wiring as defined in Section 26 29 13 of the specifications shall be provided under Division 26; control wiring as defined in Section 26 29 13 of the specifications shall be provided under Division 21/22/23.

(2) Wiring from alarm contacts to alarm systems provided by Division 26, wiring from auxiliary contacts to air handling system controls provided by Division 23. Division 26 shall provide power to smoke detector. Smoke detectors required for all air handling systems 2000 CFM or greater. Refer to other Division 23 specifications, Division 26 and Drawings for more specific requirements.

(3) For requirements for Magnetic Motor Starters, refer to Section 23 89 65 - MOTOR CONTROLLERS.

(4) For requirements for Variable Speed (Frequency) AC drives, refer to Section 23 89 65 - MOTOR CONTROLLERS.

(5) Disconnect switches, operating switches, starters and other similar items that are factory-mounted, as a part of complete assembly, shall comply with applicable provisions of the National Electric Code. All such disconnect switches shall be fused.

(6) Power wiring from energy source to controllers and automatic transfer switch provide shall be provided under Division 26. Interconnection power and control wiring from controllers and automatic transfer switch to pumps shall be provided under Division 21, 22 or 23 and conforming to Division 26 specifications. Control wiring from automatic transfer switch to generator starter shall be provided under Division 26.

(7) Division 26 will provide power to all smoke and combination fire/smoke dampers, and Division 28 will provide control for all such dampers using area smoke detectors.

(8) Wiring for sprinkler system controls to be provided by Division 21. Wiring from devices to Fire Alarm System to be provided by Division 28.

B. Connections: Make all connections to controls that are directly attached to ducts, piping and mechanical equipment with flexible connections.

C. PRECEDENCE

1. In general, piping systems that require a stated grade for proper operation shall have precedence over other systems.

2. Precedence for pipe, conduit and duct systems shall be as follows.

a. Building lines
b. Structural members
c. Soil and drain piping
d. Vent piping
e. Steam piping
f. Condensate piping
g. Refrigerant piping
h. Electrical bus duct
i. Supply ductwork
j. Return ductwork
k. Exhaust ductwork
l. Chilled water and heating water piping
m. Automatic Fire Protection Sprinkler Piping
n. Natural gas piping
o. Domestic hot and cold water piping
p. Electrical conduit

3. Lighting Fixtures shall have precedence over air grilles and diffusers.

D. FINAL INSPECTION AND REPORT

1. At the completion of the work, there shall be a meeting of the Fire Protection, Plumbing, Mechanical, Electrical Fire Alarm and Temperature Control Contractors, representatives of mechanical and electrical equipment manufactures whose equipment was actually installed on the project, and similarly-involved individuals, who shall thoroughly inspect all systems, and who shall mutually agree that all equipment has been properly wired and installed, and that all temperature and safety controls are properly functioning. A written report of this meeting, listing those in attendance, and the companies that they represent, shall be filed with the Owner and Architect or Engineer.

END OF SECTION

SECTION 22 05 29

PLUMBING SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of supports and anchors required by this section is indicated on Drawings and/or specified in other Division 22 sections.

B. Types of supports and anchors specified in this section include the following:

1. Pipe and equipment hangers, supports, and anchors.
2. Equipment bases.

C. Supports and anchors furnished as part of factory-fabricated equipment are specified as part of equipment assembly in other Division 22 sections.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of supports and anchors, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. Code Compliance: Comply with applicable plumbing codes pertaining to product materials and installation of supports and anchors.
2. MSS Standard Compliance:
    a. Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-58.
    b. Select and apply pipe hangers and supports, complying with MSS SP-69.
    c. Fabricate and install pipe hangers and supports, complying with MSS SP-89.
    d. Terminology used in this section is defined in MSS SP-90.

C. All hangers, supports and attachments shall be manufactured with materials compatible with the environment in which they will be installed. Unless directed otherwise, all hangers, supports, and attachments installed exterior to the building or within high humidity environments shall be galvanized steel or stainless steel.

D. Manufacturers of Hangers and Supports:

1. Manufacturer: Subject to compliance with requirements, provide hangers and supports of one of the following:
    a. B-Line Systems Inc. (Cooper)
    b. ANVIL International

1.3 SUBMITTALS

A. Submit product data and shop drawings as required under provisions of Division 01 and Section 22 00 10.

B. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor.

C. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly of components.

D. Maintenance Data: Submit maintenance data and parts list for each type of support and anchor. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 01.

PART 2 - PRODUCTS

2.1 HORIZONTAL-PIPING HANGERS AND SUPPORTS

A. General: Except as otherwise indicated, provide factory-fabricated horizontal-piping hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems.

B. Adjustable Steel Clevis Hangers: MSS Type 1.

C. Steel Double Bolt Pipe Clamps: MSS Type 3.

D. Steel Pipe Clamps: MSS Type 4.

E. Adjustable Steel Band Hangers: MSS Type 7.

F. Adjustable Band Hangers: MSS Type 9.

G. Adjustable Swivel Rings, Band Type: MSS Type 10.

H. Extension Split Pipe Clamps: MSS Type 12.

I. U-Bolts: MSS Type 24.

J. Pipe Slides and Slide Plates: MSS Type 35, including one of the following plate types:

1. Plate: Unguided type.
2. Plate: Guided type.
3. Plate: Hold-down clamp type.

K. Pipe Saddle Supports: MSS Type 36, including steel pipe base-support and cast-iron floor flange.

L. Pipe Stanchion Saddles: MSS Type 37, including steel pipe base support and cast-iron floor flange.

M. Adjustable Pipe Saddle Supports: MSS Type 38, including steel pipe base support and cast-iron floor flange.

N. Single Pipe Rolls: MSS Type 41.

O. Adjustable Roller Hangers: MSS Type 43.

2.2 VERTICAL-PIPING CLAMPS

A. General: Except as otherwise indicated, provide factory-fabricated vertical-piping clamps complying with MSS SP-58, of one of the following types listed, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper-plated clamps for copper-piping systems.

B. Two-Bolt Riser Clamps: MSS Type 8.

C. Four-Bolt Riser Clamps: MSS Type 42.

2.3 HANGER-ROD ATTACHMENTS

A. General: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems.

B. Steel Turnbuckles: MSS Type 13.

C. Steel Clevises: MSS Type 14.

D. Swivel Turnbuckles: MSS Type 15.

E. Malleable Iron Sockets: MSS Type 16.

F. Steel Weldless Eye Nuts: MSS Type 17.

2.4 BUILDING ATTACHMENTS

A. General: Except as otherwise indicated, provide factory-fabricated building attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Provide copper-plated building attachments for copper-piping systems.

B. Top Beam C-Clamps: MSS Type 19.

C. Side Beam or Channel Clamps: MSS Type 20.

D. Center Beam Clamps: MSS Type 21.

E. Welded Beam Attachments: MSS Type 22.

F. C-Clamps: MSS Type 23.

G. Top Beam Clamps: MSS Type 25.

H. Side Beam Clamps: MSS Type 27.

I. Steel Beam Clamps W/Eye Nut: MSS Type 28.

J. Linked Steel Clamps W/Eye Nut: MSS Type 29.

K. Malleable Beam Clamps: MSS Type 30.

L. Steel Brackets: One of the following for indicated loading:

1. Light Duty: MSS Type 31, suspending 750 lbs. max.

2. Medium Duty: MSS Type 32, suspending 1500 lbs. max.
3. Heavy Duty: MSS Type 33, suspending 3000 lbs. max.

M. Side Beam Brackets: MSS Type 34.

N. Plate Lugs: MSS Type 57.

2.5 CONCRETE INSERTS

A. Cast-In-Place Spot Type: Malleable iron, or steel with recommended insert nut. Size inserts nut to suit threaded hanger rod. MSS SP-69, Type 18.

B. Drill-In Spot Type: Steel, attached wedge, lock washer and nut. Size inserts to suit threaded hanger rod.

1. Acceptable Manufacturers and Models:

a. Hilti "Kwik Bolt"

b. Ramset "Wedge Anchor"

c. Rawl "Stud"

C. Continuous Channel Type: Steel, anchoring lugs, with channel nuts, rated for 2000 lbs. per foot minimum load. Size channel nut to suit threaded hanger rod.

1. Acceptable Manufacturers and Models:

a. B-Line B22

b. Elcen 1150

c. Unistrut P3200

2.6 SADDLES AND SHIELDS

A. General: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.

B. Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.

C. Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation.

D. Thermal Hanger Shields: Constructed of 360° insert of high density, 125-psi compressive strength, and water-proofed calcium silicate, encased in 360° sheet metal shield. Provide assembly of same thickness as adjoining insulation.

1. Manufacturer: Subject to compliance with requirements, provide thermal hanger shields of one of the following:

a. Elcen Metal Products Co.

b. Pipe Shields, Inc.

2.7 SPRING HANGERS AND SUPPORTS

A. General: Except as otherwise indicated, provide factory-fabricated spring hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select spring hangers and supports to suit pipe size and loading.

B. Restraint Control Devices: MSS Type 47.

C. Spring Cushion Hangers: MSS Type 48.

D. Spring Cushion Roll Hangers: MSS Type 49.

E. Spring Sway Braces: MSS Type 50.

F. Variable Spring Hangers: MSS Type 51; preset to indicated load and limit variability factor to 25%.

G. Variable Spring Base Supports: MSS Type 52; preset to indicated load and limit variability factor to 25%; include load flange.

H. Variable Spring Trapeze Hangers: MSS Type 53; preset to indicated load and limit variability factor to 25%.

I. Constant Supports: Provide one of the following types, selected to suit piping system. Include auxiliary stops for erection and hydrostatic test, and field load-adjustment capability.

1. Horizontal Type: MSS Type 54.
2. Vertical Type: MSS Type 55.
3. Trapeze Type: MSS Type 56.

2.8 MANUFACTURERS OF HANGERS AND SUPPORTS

A. Manufacturer: Subject to compliance with requirements, provide hangers and supports of one of the following:

1. B-Line Systems Inc.
2. ITT Grinnell Corp.

2.9 MISCELLANEOUS MATERIALS

A. Metal Framing: Provide products complying with NEMA STD ML 1.

B. Steel Plates, Shapes and Bars: Provide products complying with ASTM A 36.

C. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

D. Auxiliary Steel: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS standards.

E. Pipe Guides: Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of bolted two-section outer cylinder and base with two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

2.10 ROOF EQUIPMENT SUPPORTS

A. General: Construct roof equipment supports using minimum 18-ga galvanized steel with fully mitered and welded corners, 3 in. cant, internal bulkhead reinforcing, integral base plates, pressure treated wood nailer, and 18-ga galvanized steel counter flashing.

B. Configuration: Construct of sizes as indicated, compensate for slope in roof so top of support is dead level.

C. Manufacturer: Subject to compliance with requirements, provide roof equipment supports of one of the following:

1. Pate Co.
2. Thycurb Div.; Thybar Corp.

2.11 ROOF PIPING SUPPORTS

A. Provide adjustable height “Pipe-Prop” supports as manufactured by JMB Industries ((817) 590-0120) or equal for supporting roof mounted condensate drain piping: for pipes up to 2 in. Supports shall consist of a molded base, a molded pipe support bracket, and a length of 3/4 in. UV-resistant CPVC piping between the base and pipe support bracket. The CPVC pipe shall be cut to length to provide the required elevation to maintain proper slope at each location. Install per manufacturer’s instructions. Coordinate exact locations of supports with Roofing Contractor. Roofing Contractor shall provide roofing material pads under all supports.

2.12 ROOF PENETRATION SYSTEMS

A. General: Construct roof penetration systems utilizing the “Alumi-Flash” system by Portals Plus, Inc., or equal by Thy-Curb.

B. Each roof penetration shall include a spun aluminum base (“High” size if required due to the existing roof construction and any insulation thickness) and an EPDM rubber cap. Each rubber cap shall have a pre-molded pipe opening and shall be selected based on the actual pipe or conduit size required at each location. Secure each rubber cap to each pipe or conduit with the manufacturer’s recommended stainless steel gear clamp.

C. Manufacturer: Subject to compliance with requirements, provide roof penetration systems of one of the following:

1. Portals Plus, Inc.
2. Thycurb Div.; Thybar Corp.

2.13 CONCRETE HOUSEKEEPING BASES

A. Concrete housekeeping bases shall be in accordance with Division 03 and constructed of 3,000 psi concrete and reinforced with welded wire fabric in accordance with ASTM A 185 or deformed reinforcing bar in accordance with ASTM A 615, Grade 60.

B. Reinforcement shall be provided for base thickness as follows unless otherwise noted:

Thickness of Base	Size and Type of Reinforcement	Spacing and Location of Reinforcement
4 in.	W 2.9 x 2.9 welded	6 in. x 6 in. at centerline of pad

6 in.	No. 3 bars	18 in. on center each way (3 in. from top of pad)
8 in.	No. 4 bars	18 in. on center each way (3 in from top of pad)
12 in.	2 sets of No. 4 bars	Two mats 18 in. on center each way (3 in. from top of pad and 3 in. from bottom of pad)

2.14 SLEEVES, INSETS AND FASTENINGS

A. Pipes passing through concrete or cinder walls and floor or other corrosive material shall be protected by a protective sheathing or wrapping or by sleeves, as required to meet the local code. Annular spaces between sleeves and pipes shall be filled or tightly caulked in an approved manner. Annular spaces between sleeves and pipes in fire-resistance-rated assemblies shall be filled or tightly caulked in accordance with the local code.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which supports and anchors are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 PREPARATION

A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments.

B. Prior to installation of hangers, supports, anchors and associated work, Installer shall meet at project site with Contractor, installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section and Engineer for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

3.3 INSTALLATION OF BUILDING ATTACHMENTS

A. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at all changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through openings at top of inserts.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Install additional at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at all changes in direction of piping. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

C. Support fire-water piping independently of other piping.

D. Prevent electrolysis in support of copper tubing by use of hangers and supports that are copper plated, or by other recognized industry methods.

E. Support and laterally brace vertical pipe runs at every floor level and at intervals not to exceed 20 ft. 0 in. Support vertical pipe with riser clamps installed below hubs, couplings or lugs welded to the pipe.

F. Provisions for Movement:

1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.
2. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
3. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 Pressure Piping Codes are not exceeded.

G. Insulated Piping: Comply with the following installation requirements.

1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.
2. Piping hangers shall be sized large enough to allow insulation to pass through. Hangers for piping 2-1/2 in. and greater shall be provided with pipe covering protection saddle, or high compressive strength insulation saddle. Hangers for piping 2 in. and less shall be provided with pipe covering shields. On cold or chilled water piping provide vapor barrier through hanger.
3. Do NOT utilize "pipe size" hangers with insulation placed over the pipe and hanger.

H. Unless directed otherwise, all hangers, supports, and attachments installed exterior to the building or within high humidity environments shall be galvanized steel or stainless steel.

3.5 INSTALLATION OF ANCHORS

A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31, and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure. Comply with ANSI B31 and with AWS standards.

C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions, to limit movement of piping and forces to maximums recommended by manufacturer for each unit.

D. Anchor spacings: Where not otherwise indicated, install anchors at ends of principal pipe-runs, at intermediate points in pipe-runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

3.6 CONCRETE HOUSEKEEPING BASES

A. Provide concrete housekeeping bases for all floor-mounted equipment furnished as part of the work of Division 22 in accordance with Division 03. Size bases to extend minimum of 4 in. beyond equipment base in any direction; and 4 in. above finished floor elevation, unless otherwise noted on Drawing. Construct of reinforced concrete, roughen floor slab beneath base for bond, and provide steel rod anchors between floor and base. Locate anchor bolts using equipment manufacturer's templates. Chamfer top and edge corners.

3.7 EQUIPMENT SUPPORTS

A. Provide structural steel stands to support equipment not floor mounted or hung from structure. Construct of structural steel members or steel pipe and fittings. Provide factory-fabricated tank saddles for tanks mounted on steel stands.

B. Furnish roof equipment supports to Contractor for installation as part of work of Division 07; not work of this section.

3.8 ADJUSTING AND CLEANING

A. Hanger Adjustments: Adjust hangers so as to distribute loads equally on attachments.

B. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.

C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

SECTION 22 05 53

PLUMBING IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of mechanical identification work required by this section is indicated on Drawings and/or specified in other Division 22 sections.

B. Types of identification devices specified in this section include the following:

1. Plastic Pipe Markers.
2. Plastic Tape.
3. Underground-Type Plastic Line Marker.
4. Valve Tags.
5. Valve Schedule Frames.
6. Engraved Plastic-Laminate Signs.
7. Plastic Equipment Markers.
8. Plasticized Tags.

C. Plumbing identification furnished as part of factory-fabricated equipment, is specified as part of equipment assembly in other Division 22 sections.

D. Refer to other Division 22 sections for identification requirements at central-station mechanical control center; not work of this section.

E. Refer to Division 21, 23 and 26 sections for identification requirements of fire protection, mechanical and electrical work; not work of this section.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.

B. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2 in. x 11 in. bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule. In addition to mounted copies, furnish extra copies for Maintenance Manuals as specified in Division 01.

C. Maintenance Data: Include product data and schedules in maintenance manuals; in accordance with requirements of Division 01.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide mechanical identification materials of one of the following:

1. Allen Systems, Inc.
2. Brady (WHO) Co.; Signmark Div.
3. Industrial Safety Supply Co., Inc.
4. Seton Name Plate Corp.

2.2 IDENTIFICATION MATERIALS

A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 22 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.3 PLASTIC PIPE MARKERS

A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1.

B. Pressure-Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color-coded, and pressure-sensitive vinyl pipe markers, complying with ANSI A13.1.

C. Small Pipes: For external diameters less than 6 in. (including insulation if any), provide full-band pipe markers, extending 360° around pipe at each location, fastened by one of the following methods:

1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
2. Adhesive lap joint in pipe marker overlap.
3. Laminated or bonded application of pipe marker to pipe (or insulation).
4. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4 in. wide; full circle at both ends of pipe marker, tape lapped 1-1/2 in.

D. Large Pipes: For external diameters of 6 in. and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:

1. Laminated or bonded application of pipe marker to pipe (or insulation).
2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2 in. wide; full circle at both ends of pipe marker, tape lapped 3 in.
3. Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.

E. Lettering: Manufacturer's standard pre-printed nomenclature that best describes piping system in each instance, as selected by Architect/Engineer in cases of variance with name as shown or specified.

F. Lettering: Comply with piping system nomenclature as specified, scheduled or shown, and abbreviate only as necessary for each application length.

1. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

2.4 PLASTIC TAPE

A. General: Provide manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.

B. Width: Provide 1-1/2 in. wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6 in., 2-1/2 in. wide tape for larger pipes.

C. Color: Comply with ANSI A13.1, except where another color selection is indicated.

2.5 UNDERGROUND-TYPE LINE MARKERS

A. General: #12 AWG copper wire.

2.6 VALVE TAGS

A. Brass Valve Tags: Provide 19-gauge polished brass valve tags with stamp-engraved piping system abbreviation in 1/4 in. high letters and sequenced valve numbers 1/2 in. high, and with 5/32 in. hole for fastener.

1. Provide 1+ in. diameter tags, except as otherwise indicated.

2. Fill tag engraving with black enamel.

B. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

C. Access Panel Markers: Provide manufacturer's standard 1/16 in. thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8 in. center hole to allow attachment.

2.7 VALVE SCHEDULE FRAMES

A. General: For each page of valve schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

2.8 ENGRAVED PLASTIC-LAMINATE SIGNS

A. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

B. Thickness: 1/16 in. for units up to 20 sq. in. or 8 in. length; 1/8 in. for larger units.

C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.9 PLASTIC EQUIPMENT MARKERS

A. General: Provide manufacturer's standard laminated plastic, color-coded equipment markers. Conform to the following color code:

1. Green: Cooling equipment and components.
2. Yellow: Heating equipment and components.
3. Yellow/Green: Combination cooling and heating equipment and components.
4. Brown: Energy reclamation equipment and components.
5. Blue: Equipment and components that do not meet any of the above criteria.
6. Red: Fire protection equipment and components.
7. For hazardous equipment, use colors and designs recommended by ANSI A13.1.

B. Nomenclature: Include the following, matching terminology on schedules as closely as possible:

1. Name and plan number.
2. Equipment service.
3. Design capacity.
4. Other design parameters such as pressure drop, entering and leaving conditions, rpm, etc.

C. Size: Provide approximate 2-1/2 in. x 4 in. markers for control devices, dampers, and valves; and 4-1/2 in. x 6 in. for equipment.

2.10 PLASTICIZED TAGS

A. General: Manufacturer's standard pre-printed or partially pre-printed accident-prevention tags, have plasticized card stock with matt finish suitable for writing, approximately 3-1/4 in. x 5-5/8 in., with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

2.11 LETTERING AND GRAPHICS

A. General: Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.

1. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification that indicates individual system number as well as service (as examples; Boiler No. 3, Air Supply No. 1H, Standpipe F12).

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Coordination: Where identification is to be applied to surfaces that require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 PIPING SYSTEM IDENTIFICATION

A. General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:

1. Pipe markers, with application system as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot non-insulated pipes.

B. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.

1. Near each valve and control device.
2. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
3. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.
4. At access doors, manholes and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced intermediately at maximum spacing of 20 ft. along each piping run.
7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

C. Piping Identification:

System	Background Color	Text Color
Domestic Cold Water	Green	White
Domestic Hot Water	Yellow	Black
Domestic Hot Water - Recirculated	Yellow	Black
Natural Gas	Yellow	Black
Storm Drain	Green	White

3.3 UNDERGROUND PIPING IDENTIFICATION

A. General: During back-filling/top-soiling of each underground piping system, install continuous underground-type line marker attached to pipe. Label and terminate wire in an accessible location. No splices in the wire are allowed.

3.4 VALVE IDENTIFICATION

A. General: Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibs, and shut-off valves at plumbing fixtures, HVAC terminal devices and similar rough-in connections of end-use fixtures and units. List each tagged valve in valve schedule for each piping system.

1. Tagging Schedule: Comply with requirements of "Valve Tagging Schedule" at end of this section.

B. Mount valve schedule frames and schedules in machine rooms where indicated or, if not otherwise indicated, where directed by Architect.

3.5 PLUMBING EQUIPMENT IDENTIFICATION

A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of plumbing equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:

1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
2. Meters, gauges, thermometers and similar units.
3. Pumps and similar motor-driven units.
4. Tanks and pressure vessels.
5. Strainers, filters and similar equipment.

B. Lettering Size: Minimum 1/4 in. for distances up to 6 ft. 0 in., and proportionately larger lettering for greater distances. Provide secondary lettering 2/3 to 3/4 of size of principal lettering.

C. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

1. Operational valves and similar minor equipment items located in non-occupied spaces (including machine rooms) may, at Installer's option, be identified by installation of plasticize tags in lieu of engraved plastic signs.

3.6 ADJUSTING AND CLEANING

A. Adjusting: Relocate any mechanical identification device, which has become visually blocked by work of this division or other divisions.

B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

3.7 EXTRA STOCK

A. Furnish minimum of 5% extra stock of each mechanical identification material required, including additional numbered valve tags (not less than 3) for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.

END OF SECTION

SECTION 22 05 93

PLUMBING TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 SUMMARY

A. Check each piece of operating equipment provided under Division 22.

B. Provide Balancing Report

1.2 QUALITY ASSURANCE

A. Independent Subcontractor: All testing, adjusting and balancing shall be performed by a Testing, Adjusting and Balancing firm that is independent from the plumbing systems installer.

B. Balancing Work: Under direct supervision of AABC accredited testing organization certified supervisor.

1.3 REFERENCES

A. Reference Standards: Comply with AABC National Standards for Total System Balance, latest edition.

1.4 SUBMITTALS

A. Certificate: Before beginning work, submit certification of AABC certified supervisor and AABC firm certification in accordance with Section 22 00 10.

B. Balancing Report: At completion of work, submit balancing report in accordance with Section 22 00 10. After adjustments have been made submit three (3) copies of a complete detailed report on mechanical systems and their operation to include:

1. Blackline prints with balance valves marked to correspond with data sheets and with thermometer locations clearly marked.
2. Data sheets showing amount of water at balance valves, instrument used.
3. Equipment and operating data including water temperatures entering and leaving the thermostatic mixing valve(s).
4. A statement outlining any abnormal or notable conditions not covered in above data. Make special note of any discrepancies between tabulated data and specified conditions.

1.5 PROJECT CONDITIONS

A. Existing Conditions: Verify following conditions before proceeding with work:

1. Installation of the designated system is complete and in full operation.

PART 2 - PRODUCTS

2.1 INSTRUMENTS

A. Calibration and maintenance of instruments shall be in accordance with manufacturer's standards and recommendations and requirements of AABC.

B. Calibration histories for each instrument shall be available for examination.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect preceding work in accordance with Section 22 00 10 - BASIC PLUMBING REQUIREMENTS.

3.2 PREPARATION

A. Water Systems:

1. Check:

a. Strainers are clean.

b. Automatic control valves operation.

c. Other conditions as required.

3.3 ADJUSTING AND BALANCING

A. General: Check, adjust and balance hot water recirculation system to meet the design performance and tabulate results on acceptable forms. Minimum data to include amperage, voltage input, and thermal heater capacity of each pump, equipment nameplate data and operating speed, pressure rise across each pump, GPM capacity of each balance valve.

B. Test Run: In order to determine that the system installation is complete and will operate satisfactorily, make a test run with equipment operating per normal temperature control schedule and sequence. Run test and operate and adjust equipment as may be required during test run.

3.4 COMPLETION SERVICES

A. Final Check: Make final checks and do any rebalancing as directed.

B. Report: Submit Balancing Report as specified above.

C. Acceptance: Final acceptance of the project will not be made until a satisfactory report is received. Owner reserves the right to spot check the report by field verification prior to final acceptance.

END OF SECTION

SECTION 22 07 16

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of plumbing insulation required by this section is indicated on Drawings and schedules, and by requirements of this section.

B. Types of mechanical insulation specified in this section include the following:

1. Piping System Insulation:

a. Fiberglass.

b. Elastomeric Foam.

C. Refer to Section 22 05 29 - PLUMBING SUPPORTS AND ANCHORS for protection saddles, protection shields, and thermal hanger shields; not work of this section.

1.2 REFERENCES

A. North American Commercial and Industrial Insulation Standards. 9th Edition or Latest Edition. Published by Midwest Insulation Contractors Association (MICA).

B. NAIMA CI228 Guide to Insulating Chilled Water Piping Systems with Mineral Fiber Pipe Insulation 33°F to 60°F (0.5°C to 15.6°C) First Edition, 2015. Published by North American Insulation Manufacturers Association (NAIMA).

C. UL 723 Standard for Test for Surface Burning Characteristics of Building Materials.

D. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials.

E. ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials.

F. ASTM C335 Standard Test Method for Steady-State Heat Transfer Properties of Pipe Insulation.

G. ASTM C534 Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

H. ASTM C547 Standard Specifications for Mineral Fiber Pipe Insulation.

I. ASTM C585 Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for nominal sizes of Pipe and Tubing (NPS System).

J. ASTM C795 Standard Specifications for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

K. ASTM C1136 Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.

L. ASTM C1393 Standard Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Installer's Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.

C. Flame/Smoke Ratings: Provide composite mechanical (insulating material, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (UL723) method.

1. Exception: Outdoor mechanical insulation may have flame-spread index of 75 and smoke developed index of 150.
2. Exception: Industrial mechanical insulation that will not affect life safety egress of building may have flame-spread index of 75 and smoke developed index of 150.

D. Insulations shall not contain formaldehyde, asbestos, lead, mercury, mercury compounds, or poly-brominated diphenyl ether fire retardants.

E. Fiberglass insulations shall have a minimum of 50 percent recycled glass content; certified and UL validated.

F. Fiberglass insulations shall have a bio-based, formaldehyde-free binder and be UL GREENGUARD gold certified.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:

1. Fiberglass Products:
    a. Knauf Insulation
    b. Manson Insulation
    c. Owens / Corning
    d. Johns Manville
2. PVC Fitting Covers / Jacket:
    a. Proto LoSmoke PVC
    b. Johns Manville Zeston PVC
3. Coatings, Sealants, and Adhesives:

a. Childers Products / H.B. Fuller Construction Products

b. Foster Products / H.B. Fuller Construction Products

c. Vimasco Corporation

d. Mon-Eco Industries

2.2 PIPING INSULATION MATERIALS

A. Fiberglass Piping Insulation: ASTM C 547, Type 1 unless otherwise indicated.

B. Jackets for Piping Insulation: ASTM C 921 and ASTM C 1136, Type I (Vapor Barrier) for piping with temperatures below ambient, Type II for piping with temperatures above ambient. Type I may be used for all piping at Installer's option.

1. Encase pipe fittings insulation with one-piece pre-molded PVC fitting covers, fastened as per manufacturer's recommendations, ASTM D 1784.

2. Encase exterior piping insulation with aluminum jacket with weather-proof construction, ASTM C 1729.

C. Staples, Bands, Wires and Cement: As recommended by insulation manufacturer for applications indicated.

D. Adhesives, Sealers and Protective Finishes: As recommended by insulation manufacturer for applications indicated.

2.3 METAL PROTECTIVE JACKET

A. Sheet aluminum: ASTM C1729, 3003 alloy, H-14 temper, and 0.016 in. thick. Provide moisture barrier lining for service temperatures 60°F or less except where applied over a Type I or II jacket. Longitudinal lap shall be at least two in. wide.

B. Fitting covers: Factory fabricated from not lighter than 0.020 in. thick type 3003 sheet aluminum.

C. Bands: 3/4 in wide aluminum on maximum 18 in. centers.

D. Provide metal jackets over insulation as follows:

1. All piping exposed to outdoor weather.

2. Piping exposed in building within five (5) ft. of the floor that connect to sterilizers, kitchen and laundry equipment.Seal without the use of screens or pop rivits. Provide aluminum angle ring escutcheons at wall, ceiling and floor penetrations.

3. A two in. overlap is required at longitudinal and circumferential joints.

E. Provide PVC jackets, color coded per ASHRAE, over insulation as follows:

1. Piping exposed in building.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

B. Thickness of insulation shall be as recommended by the manufacturer for the temperatures and pipe sizes involved, and in accordance with standards of North American Insulation Manufacturers Association (NAIMA).

3.2 PLUMBING PIPING SYSTEM INSULATION

A. Insulation Omitted: Omit insulation on chrome-plated exposed piping (except for handicapped fixtures), air chambers, unions, strainers, check valves, balance cocks, flow regulators, drain lines from water coolers, drainage piping located in crawl spaces or tunnels, buried piping, fire protection piping, and pre-insulated equipment.

B. Cold Piping:

1. Application Requirements: Insulate the following cold plumbing piping systems:
    a. Potable cold water piping.
    b. Plumbing vents within 6 linear ft. of roof outlet.
    c. Condensate drains from HVAC units, refrigerated equipment, etc., including traps and lateral lines concealed above ceilings.
    d. Waste and vent piping above grade and located outside the building insulation envelope.
2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:
    a. Fiberglass: 1 in. thickness; ½ in. thick for condensate drain piping.

C. Hot Piping:

1. Application Requirements: Insulate the following hot plumbing piping systems:
    a. Potable hot water piping.
    b. Hot drain piping (where indicated).
2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:
    a. Fiberglass (Above Ground Only): 1 in. thick for pipe sizes up to and including 1-1/4 in., 1-1/2 in. thick for pipe sizes 1-1/2 in. and larger.
    b. All insulation requirements shall comply with applicable edition of IECC.

3.3 INSTALLATION OF PIPING INSULATION

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

B. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance of tests.

C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

D. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

E. Maintain integrity of vapor-retarder jackets on pipe insulation, and protect to prevent puncture or other damage. All penetrations of the jacket and exposed ends of insulation shall be sealed with vapor barrier coating.

F. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.

G. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.

H. Butt pipe insulation against pipe hanger insulation inserts. For hot pipes, apply 3 in. wide vapor barrier tape or band over the butt joints. For cold piping apply wet coat of vapor barrier lap cement on butt joints and seal joints with 3 in. wide vapor barrier tape or band.

I. Do NOT insulate over pipe hangers. If pipe hangers for piping to be insulated are not adequately sized for insulation to pass through the hanger, notify the General Contractor and Architect.

3.4 INSULATION EXPOSED TO WEATHER

A. Protect outdoor insulation from weather by installation of weather-barrier metal jacketing. It may be factory-applied or field applied. Joints shall be overtapped a minimum of 2 inches. Securement shall be accomplished by using stainless steel bands. Any vapor-barrier jacket or coating under the metal jacketing shall not be disturbed or punctured by the use of screws or rivets on the outer jacket.

3.5 EXISTING INSULATION REPAIR

A. Repair damaged sections of existing mechanical insulation, both previously damaged or damaged during this construction period. Use insulation of same thickness as existing insulation, install new jacket lapping and sealed over existing.

3.6 PROTECTION AND REPLACEMENT

A. Replace damaged insulation that cannot be repaired satisfactorily, including units with vapor barrier damage and moisture-saturated units.

B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION

SECTION 22 10 00

PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of Plumbing Piping Work required by this section is indicated on Drawings and by requirements of this section.

B. Types of Plumbing Piping systems specified in this section include the following:

1. Sanitary waste and vent system.
2. Domestic water system.
3. Miscellaneous Drain Lines
4. Compressed air system.

1.2 REFERENCES

A. ANSI/ASME B16.18 - Cast Copper Alloy Solder - Joint Pressure Fittings.

B. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

C. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings Class 150 NS 300.

D. ANSI/ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV.

E. ANSI/ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.

F. ANSI/ASME Sec. 9 - Welding and Brazing Qualifications.

G. ANSI/ASTM B32 - Solder Metal.

H. ANSI/ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

I. ANSI/ASTM D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

J. ANSI/AWS D1.1 - Structural Welding Code.

K. AWS D10.12 - Recommended Practices and Procedures for Welding Plain Carbon Steel Pipe.

L. AWS D10.9 - Qualifications and Procedures for Piping and Tubing Welding.

M. AWS B3.0 - Welding Procedure and Performance Qualification.

N. ANSI/AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.

O. ANSI/AWWA C110 - Ductile Iron and Gray Iron Fittings 3 in. through 48 in., for Water and Other Liquids.

P. ANSI/AWWA C111 - Rubber-Gasket Joints for Ductile Iron and Gray-Iron Pressure Pipe and Fittings.

Q. ANSI/AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

R. ASME - Boiler and Pressure Vessel Code.

S. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

T. ASTM A74 - Cast Iron Soil Pipe and Fittings.

U. ASTM A120 - Pipe, Steel, Black and Hot-Dipped Zinc Coated (Galvanized), Welded and Seamless, for Ordinary Uses.

V. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

W. ASTM A888/ CISPI Standard 301 for Cast Iron hubless pipe and fittings.

X. ASTM B88 - Seamless Copper Water Tube.

Y. ASTM B306 - Copper Drainage Tube (DWV).

Z. ASTM C14 - Concrete Sewer, Storm Drain, and Culvert Pipe.

AA. ASTM C425 - Compression Joints for Vitrified Clay Pipe and Fittings.

BB. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

CC. ASTM C 1540 - Heavy Duty Shielded Hubless Couplings

DD. ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.

EE. ASTM D2235 - Solvent Cement for Acrylonitrile - Butadiene - Styrene (ABS) Plastic Pipe and Fittings.

FF. ASTM D2241 - Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR).

GG. ASTM D2321 - Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity- flow Applications.

HH. ASTM D2513 - Thermoplastic Gas Pressure Pipe, Tubing and Fittings.

II. ASTM D2665 - Poly (Vinyl Chloride) (PVC) Plastic Drain Waste and Vent Pipe and Fittings.

JJ. ASTM D2680 - Acrylonitrile - Butadiene - Styrene (ABS) Composite-Sewer Piping.

KK. ASTM D2683 - Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe.

LL. ASTM D2751 - Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.

MM. ASTM D2855 - Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVS) Pipe and Fittings.

NN. ASTM D3033 - Type PSP Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

OO. ASTM D3034 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

PP. ASTM E84 - Standard test method for surface burning characteristics of building materials.

QQ. ASTM F477 - Electrometric Seals (Gaskets) for Joining Plastic Pipe.

RR. AWS A5.8 - Brazing Filler Metal.

SS. AWWA C651 - Standard for Disinfecting Water Mains.

TT. AWWA C601 - Standard Methods for the Examination of Water and Waste Water.

UU. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.

VV. CISPI 310 - Couplings for Use with Hubless Cast Iron Soil Pipe and Fittings.

WW. ASTM D2564 - Solvent Cements for Poly (vinyl) (chloride) (PVC) Plastic Pipe and Fittings.

XX. NFPA 24 - Installation of private fire service mains and their Appurtenances, latest edition.

YY. NFPA 54 - National Fuel Gas Code, latest edition.

ZZ. ANSI LC-1 / CSA 6.26 - Use and Installation of Corrugated Stainless Steel Tubing (CSST).

1.3 QUALITY ASSURANCE

A. Plumbing Certification: Persons performing plumbing work shall have a current Texas State Plumbing License.

B. Valves: Manufacturer's name and pressure rating marked on valve body.

C. Welding Materials and Procedures: Conform to ASME Code and AWS 10.12.

D. Welders Certification: In accordance with ANSI/ASME Sec. 9 or AWS D1.1, AWS D10.9, and AWS B3.0, as applicable.

E. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute or receive prior approval of the engineer.

F. All adhesives, sealants and sealant primers shall contain low VOC (Volatile Organic Compounds), as outlined in the South Coast Air Quality Management District (SCAQMD) Rule #1168. The design intent for this project is to obtain LEED Credit 4.1, which requires that all adhesives, sealants and sealant primers comply with the SCAQMD Rule #1168.

1.4 REGULATORY REQUIREMENTS

A. Conform to the most recent editions of the applicable City codes and ordinances and NFPA 54.

B. Piping materials specified herein are acceptable products to the Architect, but all are not necessarily acceptable to applicable local codes and ordinances. It is the responsibility of the Contractor to provide materials, from the options listed herein, that are acceptable to both the Architect and applicable local codes and ordinances.

1.5 SUBMITTALS

A. Submit product data on pipe materials, fittings, valves and accessories in accordance with Division 01 and Section 22 00 10.

B. Submit shop drawings and piping layout in accordance with Division 01 and Section 22 00 10.

C. Submit certificates as listed below to Architect in accordance with Division 01 and Section 22 00 10.

1. Test Certificates of Approval for Piping Systems.
2. Flushing Certificates of Approval for Piping Systems.
3. Disinfection Certificates of Approval for Domestic Water Piping Systems.

1.6 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

PART 2 - PRODUCTS

2.1 SANITARY WASTE AND VENT PIPING

A. Sanitary waste and vent piping, below grade.

1. Cast Iron Pipe & Fittings: ASTM A74 service weight. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets.

B. Sanitary waste and vent piping, above grade.

1. Cast Iron Pipe & Fittings: CISPI 301, hubless. Joints: ASTM C 564, neoprene gaskets and stainless steel clamp-and-shield assemblies. Joints shall be Heavy Duty couplings conforming to ASTM C 1540 as manufactured by Husky SD 4000 or Clamp All 125.

C. Sanitary waste and vent piping for aggressive application, above grade.

[i.e. Exposure to undiluted cleaning chemicals with a pH range of 2 to 12, Hospitals, Casinos, Commerical kitchens, Soada fountains, Bar sinks, Parking garages.]

1. Epoxy coated Cast Iron Pipe and Fittings, ASTM A888/CISPI 301, hubless. Joints: ASTM C564 neoprene gaskets and Heavy Duty stainless steel clamp-and-shield assemblies conforming to ASTM C1540. Epoxy cast iron pipe shall be Charlotte Edge HP or by NewAge Casting.

2.2 WATER PIPING

A. Water piping, above grade.

1. Copper Tubing: For 4 in. diameter and less, ASTM B88, Type "L", hard drawn. Fittings: ANSI/ASME B16.18, cast brass, or ANSI/ASME B16.22, wrought copper. Joints: ANSI/ASTM B32, solder, Grade 95TA.

2. Mechanically pressed copper fittings are preferred for pipe sizes 1/2 in. through 4 in. diameter. Operating pressure: 200 PSI CWP Max, Temperature range: -20°F to 250°F. Fittings shall conform with ASME B16.18, ASME B16.22 or ASME B16.26, and performance criteria of IAPMO PS-117 or ASME B16.51. Fittings shall utilize a factory installed EPDM sealing element and be listed by NSF 61. The installer shall be trained and certified by the fitting manufacturer. Copper press fittings shall be installed using the proper tool, actuator, jaws and rings as instructed by the press fitting manufacturer. Acceptable products are Apollo Press, Viega ProPress or Mueller Industries Streamline PRS.

2.3 MISCELLANEOUS DRAIN PIPING

A. Condensate Drain Piping:

1. Copper pipe; ASTM B306, DWV fittings; ANSI/ASME B16.3, cast bronze, or AWSI/ASME B16.29, wrought copper. Joints: ANSI/ASTM B32, solder, Grade 50B.

2. Mechanically pressed copper fittings are acceptable for pipe sizes 1/2 in. through 4 in. diameter. Operating pressure: 200 PSI CWP Max, Temperature range: -20°F to 250°F. Fittings shall conform with ASME B16.18, ASME B16.22 or ASME B16.26, and performance criteria of IAPMO PS-117 or ASME B16.51. Fittings shall utilize a factory installed EPDM sealing element. The installer shall be trained and certified by the fitting manufacturer. Copper press fittings shall be installed using the proper tool, actuator, jaws and rings as instructed by the press fitting manufacturer. Acceptable products are Apollo Press, Viega ProPress or Mueller Industries Streamline PRS.

2.4 COMPRESSED AIR PIPING

A. Compressed air piping, above ground.

1. Copper Tubing: ASTM B88, Type "K" hard drawn. Fittings: ANSI/ASME B16.18, cast brass, or ANSI/ASME B16.22, wrought copper. Joints: ANSI/ASTM B32, solder, Grade 95TA.
2. Mechanically pressed copper fittings are acceptable for pipe sizes 1/2 in. through 4 in. diameter. Operating pressure: 200 PSI CWP Max, Temperature range: -20°F to 250°F. Fittings shall conform with ASME B16.18, ASME B16.22 or ASME B16.26, and performance criteria of IAPMO PS-117 or ASME B16.51. Fittings shall utilize a factory installed EPDM sealing element. The installer shall be trained and certified by the fitting manufacturer. Copper press fittings shall be installed using the proper tool, actuator, jaws and rings as instructed by the press fitting manufacturer. Acceptable products are Apollo Press, Viega ProPress or Mueller Industries Streamline PRS.
3. Steel Pipe: ASTM A53 or A120, Schedule 40 black. Fittings: ANSI/ASME B16.3 malleable iron or ASTM A234 forged steel welding type. Joints: Screwed or ANSI/ AWS D1.1 welded.

2.5 FLANGES, UNIONS AND COUPLINGS

A. Pipe Size 2 in. and under: 150 psig malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, soldered joints.

B. Pipe Size Over 2 in.: 150 psig forged steel slip-on flanges for ferrous piping; bronze flanges for copper piping; gaskets suitable for intended service – NO ASBESTOS GASKET MATERIAL ALLOWED.

C. Grooved and Shouldered Pipe End Couplings: Malleable iron housing clamps to engage and lock, designed to permit some angular deflection, contraction and expansion; “C” shape composition sealing gasket; steel bolts, nuts, and washers; galvanized couplings for galvanized pipe.

1. Acceptable Manufacturers:
    a. Victaulic
    b. Apollo Shurjoint

D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, and water impervious isolation barrier.

2.6 BALL VALVES

A. Ball valves: For water, natural gas, and compressed air shut-off and throttling.

1. Ball valves 2 in. and less: Rated 175 lb. minimum water, oil, air and gas pressure, brass or bronze construction, seat material as recommended by manufacturer for material conveying, lever handle, threaded or soldered connections. Throttling valves shall be provided with memory stops (for establishing any setpoint from 0-100% flow).
    a. Acceptable Manufacturers and Models:
        1) Crane 9302, 9322
        2) Apollo 70 Series
        3) Jomar T-100-SS
        4) ITT Grinnell 3500, 3500SJ
        5) Milwaukee BA-200, BA-250
        6) Watts B-6000, B-6001
        7) Nibco T-580, & S-500
        8) KITZ 868

B. Ball valves: For deionized water shut-off and throttling.
    1. Ball valves: Rated 200 lb. minimum water pressure at 73°F, CPVC constructed body and ball, “Viton” O-ring seals, “Teflon” ball seals, union type, socket type connections.
        a. Acceptable Manufacturers and Models:
            1) R&G Sloan Asahi/America

2.7 BUTTERFLY VALVES

A. Butterfly Valves: For water, natural gas, and compressed air shut-off and throttling.
    1. Butterfly valves 2 in. and less: Rated 175 lb. water, oil, air and gas pressure, brass or bronze construction, seat material as recommended by manufacturer for material conveying, lever handle, threaded or soldered connections. Throttling valves shall be provided with memory stops.
        a. Acceptable Manufacturers and Models:
            1) Milwaukee BB2-100, BB2-350

2.8 CHECK VALVES

A. Swing check valves: For water, air, and pumped waste and drain.
    1. Check Valves 2 in. and less: MSS SP-80 rated 175 lb. minimum water and air pressure, brass or bronze construction, renewable seat, bronze disc, threaded or soldered connections.
        a. Acceptable Manufacturers and Models:
            1) Nibco T-413
            2) Apollo 163T
            3) Crane 137
            4) Jomar T/S-511
            5) Stockham B-321
            6) Milwaukee 508

7) KITZ 822

2.9 EXCAVATION, BACKFILLING AND COMPACTING

A. Provide excavation, backfilling and compacting in accordance with Division 31 .

2.10 PIPING SPECIALTIES

A. Provide piping specialties in accordance with Section 22 11 19.

2.11 PLUMBING SUPPORTS AND ANCHORS

A. Provide supports and anchors in accordance with Section 22 05 29.

2.12 PLUMBING INSULATION

A. Provide mechanical insulation in accordance with Section 22 07 16.

PART 3 - EXECUTION

3.1 PIPING

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

E. Route piping in orderly manner and maintain gradient.

F. Install piping to conserve building space and not interfere with use of space.

G. Pipes passing through concrete or cinder walls and floor or other corrosive material shall be protected by a protective sheathing or wrapping or by sleeves, as required to meet the local code. Annular spaces between sleeves and pipes shall be filled or tightly caulked in an approved manner. Annular spaces between sleeves and pipes in fire-resistance-rated assemblies shall be filled or tightly caulked in accordance with the local code.

H. Group piping whenever practical at common elevations.

I. Exposed piping, valves, fittings, escutcheons, trim, etc., serving plumbing fixtures in finished areas, shall be polished chromium plated. Exposed piping, valves, fittings, escutcheons, trim, etc., serving plumbing equipment, kitchen equipment, or other equipment located in finished areas, shall be chrome plated, or when not available with chrome plating, they shall be painted with chromium paint.

J. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

K. Provide clearance for installation of insulation and access to valves and fittings.

L. Provide access where valves and equipment are not accessible. Coordinate size and location of access doors with applicable Section.

M. Slope water piping and arrange to drain at low points.

N. Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting. Refer to Division 09 - FINISHES

O. Install piping parallel with or at right angles to walls unless otherwise shown on Drawings.

P. Conceal piping above ceilings, in walls or chases etc., unless otherwise shown or noted on Drawings.

Q. Joints in soft copper piping below slab will not be allowed.

R. Soft copper shall not be routed through areas with exposed ceilings except in mechanical rooms.

S. Bending of rigid piping is not permitted; only ells shall be utilized for a change in direction.

T. Temporarily plug or cap open ends of pipe at the end of each workday.

U. Establish invert elevations for drainage piping. Minimum slopes for drainage are 1/4 in. per foot for 3 in. diameter and less and 1/8 in. per ft. for 4 in. diameter pipe and greater.

V. Install bell and spigot pipe with bell end upstream.

W. Install vented U-type drain trap on all draw-thru cooling coil drain pans.

X. Materials exposed within ducts or plenums (ceiling spaces used as supply or return air plenums) shall have a flame-spread index of not more than 25 and a smoke-developed rating of not more than 50 when tested in accordance with the test for Surface Burning Characteristics of Materials, U.B.C. Standard No. 42-1. Do not install any PVC piping in any Return Air Plenums.

Y. Fuel-gas lines and waste cleanouts shall not be located within an air supply plenum.

Z. Piping hangers shall be sized large enough to allow insulation to pass through. Hangers for piping 2-1/2 in. and greater shall be provided with pipe covering protection saddle, or high compressive strength insulation saddle. Hangers for piping 2 in. and less shall be provided with pipe covering shields. On cold or chilled water piping provide vapor barrier through hanger.

AA. Domestic water service piping below building shall be provided with both tie-rod and thrust block restraint in accordance with NFPA 24. Tie-rod restraint shall be provided vertically from the below floor elbow at the base of the riser out to the first hub beyond 5 ft. 0 in. from building. (See NFPA 24-1995 figure A-8-6.2 (b)). Thrust block restraint shall be provided on the below floor elbow at the base of the riser. Area of bearing face of concrete thrust block shall be 32 sq. ft.

BB. Support vertical piping at every floor.

CC. Installation of PVC plastic drainage piping under floor and underground shall be in compliance with ASTM D2321 Latest Edition “Standard Practice for Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications”. Minimum trench width shall be pipe diameter plus 16 in. and all bedding material shall meet Class 1A or Class 1B bedding criteria.

DD. Roof penetrations through metal roofs by the Plumbing or Mechanical Contractor will be required to have written approval by the Roofing Contractor.

3.2 PIPING CONNECTIONS

A. Threaded Connections

1. Threaded joints shall be in accordance with ANSI B1.20.1. Threaded joints shall be made up Teflon tape or lead free pipe joint compound applied to the male thread only. Should a joint be loosened after being made up, it shall not be made up a second time unless the threads are cleaned and new compound applied.
2. All steel piping which is assembled with screwed joints shall have exposed threads thoroughly primed with a coat of lead free rust resistant paint. Paint immediately after installation. This shall apply to both piping that is to be covered as well as uncovered.

B. Soldered Connections

1. Soldered joints shall be in accordance with ASTM B32. Flux shall be nonacid type. Remove composition discs from solder end valves during soldering. Pipe ends, fittings and valves shall be properly cleaned before soldering and wiped clean to remove flux and excess solder after soldering.

C. Welded Connections

1. Welded joints shall be in accordance with AWS D10.12-79. The oxyacetylene or electric process shall make all joints.
2. Nipples or half couplings welded into the mains will not be accepted. Welded branch connections shall be used to tap mains only where the mains are at least two pipe sizes larger than the branch.
3. All openings cut into pipe for welded outlets shall be accurately made, to give matched intersections. For welded branch outlet fittings, the opening shall be cut before the fittings welded.
4. Long radius type ells shall be on all bends in welded pipelines. No field fabricated or factory segmentally fabricated fittings shall be allowed.
5. Welds on piping shall be cleaned and primed with corrosion resistant paint before insulation is applied or installation is complete.

D. Solvent Cement Connections:

1. Solvent cement connections shall be joined with primer and PVC solvent cement complying with ASTM D2564. Solvent cement connections shall be in compliance with GSR Bulletin SCJ-1 Solvent Cementing Procedure.

E. Mechanical Grooved Connections:

1. Pipe shall be prepared and mechanical grooved connections shall be assembled in accordance with ANSI/AWWA C606 and the latest published instructions from the manufacturer.

F. Copper Press Connections:

1. Mechanical copper press fittings shall be made in strict accordance with the manufacturer's installation instructions.
    a. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool(s) approved by the manufacturer.

3.3 FLANGES AND UNIONS

A. Provide flanges and unions at all final connections to equipment, and traps. Arrange piping and piping connections so that equipment being served may be serviced or totally removed without disturbing piping beyond final connections and associated shut-off valves.

B. All flanged connections shall be in accordance with ANSI B16.5 for steel flanges and ANSI B16.1 for cast iron flanges.

C. Bolting shall be in accordance with ASTM A307 Grade B with bolts and nuts in accordance with ANSI B18.2.1 and ANSI B18.2.2.

D. Tighten flange bolts in sequence 180° directly opposite each to equal tension.

E. Flanges and unions shall be made of same material or compatible material as piping systems in which they are installed.

3.4 VALVES

A. Install valves with stems upright or horizontal, not below horizontal.

B. Horizontal swing check valves shall be installed in a true horizontal position. Vertical lift check valves shall be installed in a true vertical position.

C. Install ball valves for shut-off and to isolate equipment, parts of systems, or vertical risers.

D. Install ball valves for throttling, bypass or manual flow control services.

E. Throttling or balancing valves shall be provided with memory stops.

3.5 TESTING

A. General: Furnish pumps, gauges, equipment and personnel required, and test as necessary to demonstrate the integrity of the finished installation.

B. Soil, Waste and Vent, and Storm Drainage: Unless otherwise directed, plug all openings and fill with water to a height equal to the lowest vent or roof drain. Allow to stand one hour or longer as required. Remake leaking joints and retest.

C. Water Lines: Hydrostatically test and make tight at 150 psi. Retain for four hours. Repair all leaking joints and retest.

D. Compressed Air: Pneumatically test and make tight at 150 psi. Retain for four hours. Repair all leaking and retest.

E. Tests and test procedures shall be witnessed and approved by the Architect.

F. After completion and approval of testing, submit "Test Certificates of Approval" for Sanitary Waste and Vent, Water, Waste, and Drain piping systems stating that all test results are satisfactory. Certificates of approval must be signed by Contractor.

3.6 FLUSHING

A. General: After piping systems have been tested and approved, systems shall be flushed. Furnish compressors, pumps, equipment, personnel, etc. required to flush piping systems.

B. Water Lines: Flush piping with water until water flows clear for a minimum of 60 seconds per 100 linear ft. of piping being flushed at a velocity of 9 ft. per second.

C. Compressed Air: Flush piping with air until air flows clear for a minimum of 60 seconds per 100 linear ft. of piping being flushed at 25 CFM per 1 in. diameter of pipe.

D. All strainers and filters shall be cleaned and replaced prior to start-up.

E. Flushing and flushing procedures shall be witnessed and approved by the Architect.

F. After completion and approval of flushing, submit "Flushing Certificates of Approval" for water and compressed air piping systems stating that all flushing results are satisfactory. Certificates of approval must be signed by Contractor.

3.7 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Prior to starting work, verify system is complete, flushed and clean.

B. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50-to 80 mg/L residual.

C. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 5 remote outlets.

D. Maintain disinfectant in system for 24 hours.

E. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

F. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

G. Take samples no sooner than 24 hours after flushing, from 5 remote outlets and from water entry, and analyze in accordance with AWWA C651.

H. Disinfection and disinfection procedures shall be witnessed and approved by the Architect.

I. After disinfection is completed, submit "Disinfection Certificate of Approval" for domestic water piping systems to the Architect stating that all test results are satisfactory. Certificate of Approval must be signed by Contractor. Certificate shall show the date, time and residual of each of the following tests:

   1. Initial disinfection residual (50 PPM minimum) - 5 samples.
   2. Final disinfection residual (25 PPM minimum) - 5 samples.
   3. After flushing residual (5 PPM maximum) - 5 samples.
   4. Analyze in accordance AWWA C651 - 5 samples.

3.8 CLOSING IN UNINSPECTED WORK

A. Do not cover up or enclose work until it has been properly and completely inspected and approved. Should any of the work be covered up or enclosed prior to all required inspections and approvals, uncover the work as required. After it has been completely inspected and approved, make all repairs and replacements as necessary to the satisfaction of the Architect, Engineer, and Owner's Representative. Repairs and replacements shall be at no additional cost to the Owner.

END OF SECTION

SECTION 22 11 19
PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of piping specialties work required by this section is indicated on Drawings and schedules and by requirements of this section.

B. Types of piping specialties specified in this section include the following:

1. Pipe Escutcheons.
2. Pipeline Strainers.
3. Dielectric Unions.
4. Mechanical Penetration Seals.
5. Fire Barrier Penetration Seals.
6. Pipe Sleeves.
7. Penetration Seals.

C. Piping specialties furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division 22 sections.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of piping specialties of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. FCI Compliance: Test and rate "Y" type strainers in accordance with FCI 73-1 "Pressure Rating Standard for "Y" Type Strainers". Test and rate other type strainers in accordance with FCI 78-1 "Pressure Rating Standard for Pipeline Strainers Other than "Y" Type".

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including installation instructions, and dimensioned Drawings for each type of manufactured piping specialty. Include pressure drop curve or chart for each type and size of pipeline strainer. Submit schedule showing manufacturer's figure number, size, location, and features for each required piping specialty.

B. Shop Drawings: Submit for fabricated specialties, indicating details of fabrication, materials, and method of support.

C. Maintenance Data: Submit maintenance data and spare parts lists for each type of manufactured piping specialty. Include this data, product data, and shop Drawings in maintenance manual; in accordance with requirements of Division 01.

PART 2 - PRODUCTS

2.1 PIPING SPECIALTIES

A. General: Provide factory-fabricated piping specialties recommended by manufacturer for use in service indicated. Provide piping specialties of types and pressure ratings indicated for each service, or if not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes as indicated, and connections, which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is Installer's option.

2.2 PIPE ESCUTCHEONS

A. General: Provide pipe escutcheons as specified herein with inside diameter tightly fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime paint finish for unoccupied areas.

B. Pipe Escutcheons for Moist Areas: Exterior use and interior use including mechanical rooms and any room with water or floor type drains. For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.

C. Pipe Escutcheons for Dry Areas: Provide sheet steel escutcheons, solid or split hinged.

D. Manufacturer: Subject to compliance with requirements, provide pipe escutcheons of one of the following or approved equal:

1. Chicago Specialty Mfg. Co.
2. Producers Specialty & Mfg. Corp.
3. Sanitary-Dash Mfg. Co.

2.3 LOW PRESSURE Y-TYPE PIPELINE STRAINERS

A. General: Provide strainers full line size of connecting piping, with ends matching piping system materials. Select strainers for 125 psi working pressure, with Type 304 stainless steel screens, with 3/64 in. perforations @ 233 per sq. in.

B. Threaded Ends, 2 in. and Smaller: Cast-iron body, screwed screen retainer with centered blow down fitted with pipe plug.

C. Threaded Ends, 2+ in. and Larger: Cast-iron body, bolted screen retainer with off-center blow down fitted with pipe plug.

D. Flanged Ends, 2+ in. and Larger: Cast-iron body, bolted screen retainer with off-center blow down fitted with pipe plug.

E. Butt Welded Ends, 2+ in. and Larger: Schedule 40 cast carbon steel body, bolted screen retainer with off-center blow down fitted with pipe plug.

F. Grooved Ends, 2+ in. and Larger: Tee pattern, ductile-iron or malleable-iron body and access end cap, access coupling with EPDM gasket.

G. Manufacturer: Subject to compliance with requirements, provide low pressure Y-type strainers of one of the following or approved equal:

1. Armstrong Machine Works.
2. Hoffman Specialty ITT; Fluid Handling Div.
3. Metraflex Co.
4. R-P&C Valve; Div. White Consolidated Industries, Inc.
5. Spirax Sarco.
6. Trane Co.
7. Victaulic Co. of America.
8. Watts Regulator Co.

2.4 HIGH PRESSURE Y-TYPE PIPELINE STRAINERS

A. General: Provide strainers full line size of connecting piping, with ends matching piping system materials. Select strainers for 250 psi working pressure, with Type 304 stainless steel screens, with 3/64 in. perforations @ 233 per sq. in.

B. Threaded Ends, 2 in. and Smaller: Cast-iron body, screwed screen retainer with centered blow down fitted with pipe plug.

C. Threaded Ends, 2+ in. and Larger: Cast-iron body, bolted screen retainer with off-center blow down fitted with pipe plug.

D. Flanged Ends, 2+ in. and Larger: Cast-iron body, bolted steel retainer with off-center blow down fitted with pipe plug.

E. Butt Welded Ends, 2+ in. and Larger: Schedule 80 cast carbon steel body, bolted screen retainer with off-center blow down fitted with pipe plug.

F. Manufacturer: Subject to compliance with requirements, provide high-pressure Y-type strainers of one of the following or approved equal:

1. Armstrong Machine Works.
2. Hoffman Specialty ITT; Fluid Handling Div.
3. Metraflex Co.
4. R-P&C Valve; Div. White Consolidated Industries, Inc.
5. Spirax Sarco.
6. Trane Co.
7. Watts Regulator Co.

2.5 DIELECTRIC UNIONS

A. General: Provide standard products recommended by manufacturer for use in service indicated, which effectively isolate ferrous from non-ferrous piping (electrical conductance), prevent galvanic action, and stop corrosion.

B. Manufacturer: Subject to compliance with requirements, provide dielectric unions of one of the following or approved equal:

1. B & K Industries, Inc.
2. Capital Mfg. Co.; Div. of Harsco Corp.
3. Eclipse, Inc.

4. Epco Sales, Inc.
5. Perfection Corp.
6. Rockford-Eclipse Div.

2.6 PENETRATION SEALS

A. Caulked Seals: Provide seals for penetrations through interior walls of one of the following:
   1. Mineral Wool or Oakum: Caulked watertight between sleeve and pipe.

B. Mechanical Seals:
   1. General: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
   2. Manufacturer: Subject to compliance with requirements, provide mechanical sleeve seals of one of the following or approved equal.
      a. Thunderline Corp.

C. Fire Barrier Seals:
   1. Provide seals for any opening through smoke or fire-rated walls, and all above grade floors, used as passage for mechanical components such as piping or ductwork.
   2. Cracks, Voids, or Holes Up to 4 in. Diameter: Use putty or caulking, one-piece intumescent elastomer, non-corrosive to metal, compatible with synthetic cable jackets, and capable of expanding 10 times when exposed to flame or heat, UL-listed.
   3. Openings 4 in. or Greater: Use sealing system capable of passing 3-hour fire test in accordance with ASTM E-814, consisting of wall wrap or liner, partitions, and end caps capable of expanding when exposed to temperatures of 250 to 350°F UL-listed.
   4. Manufacturer: Subject to compliance with requirements, provide fire barrier penetration seals of one of the following or approved equal.
      a. Electro Products Div./3M.
      b. Nelson; Unit of General Signal.

2.7 DRIP PANS

A. General: Provide drip pans fabricated from 20 gauge corrosion-resistant sheet metal with watertight joints, and with edges turned up 2+ in. Reinforce top, either by structural angles or by rolling top over 1/8 in. steel rod. Provide hole, gasket, and flange at low point for watertight joint and 1 in. drain line connection.

2.8 PIPE SLEEVES

A. Provide pipe sleeves of one of the following:
   1. Sheet-Metal: Fabricate from galvanized sheet metal; round tube closed with snap lock joint, welded spiral seams, or welded longitudinal joint. Fabricate from the following gauges: 3 in. and smaller, 20 gauge; 4 in. to 6 in. 16 gauge; over 6 in., 14 gauge.
   2. Steel-Pipe: Fabricate from Schedule 10 (minimum) steel pipe; remove burrs.
   3. Floor sleeves shall be provided with water stop around perimeter of sleeve.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

A. Pipe Escutcheons: Install pipe escutcheons on each pipe penetration through floors, walls, partitions, and ceilings where penetration is exposed to view; and on exterior of building. Secure escutcheon to pipe or insulation so escutcheon covers penetration hole, and is flush with adjoining surface.

B. Y-Type Strainers: Install Y-type strainers full size of pipeline, in accordance with manufacturer's installation instructions. Install pipe nipple and shutoff valve in strainer blow down connection, full size of connection, except for strainers 2 in. and smaller installed ahead of control valves feeding individual terminals. Where indicated, provide drain line from shutoff valve to plumbing drain, full size of blow down connection.

1. Locate Y-type strainers in supply line ahead of the following equipment, and elsewhere as indicated, if integral strainer is not included in equipment:
    a. Pumps.
    b. Steam traps serving steam main drips.
    c. Temperature control valves.
    d. Pressure reducing valves.
    e. Temperature or pressure regulating valves.

C. Dielectric Unions: Install at each piping joint between ferrous and non-ferrous piping. Comply with manufacturer's installation instructions.

D. Mechanical Penetration Seals: Loosely assemble rubber links around pipe with bolts and pressure plates located under each bolt head and nut. Push into sleeve and center. Tighten bolts until links have expanded to form watertight seal.

E. Fire Barrier Penetration Seals: Fill opening with sealing compound. Adhere to manufacturer's installation instructions.

F. Drip Pans: Locate drip pans under piping passing over or within 3 ft. horizontally of electrical equipment, and elsewhere as indicated. Hang from structure with rods and building attachments, weld rods to sides of drip pan. Brace to prevent sagging or swaying. Connect 1 in. drain line to drain connection, and run to nearest plumbing drain or elsewhere as indicated.

G. Pipe Penetrations: Sleeve new construction or core drill existing construction pipe penetrations as specified below where piping passes through walls, floors, and roofs. Do not penetrate structural members, except as detailed on Drawings, or as reviewed by Architect. Install penetrations accurately centered on pipe runs. Size penetrations so that piping and insulation (if any) will have free movement in sleeve, including allowance for thermal expansion; but not less than two pipe sizes larger than piping run. Where insulation includes vapor-barrier jacket, provide penetration with sufficient clearance for installation. When sleeves are required, install length of sleeve equal to thickness of construction penetrated, and finish flush to surface; except floor sleeves. Extend floor sleeves two inches above finished floor. Provide temporary support of sleeves during placement of concrete and other work around sleeves, and provide temporary closure to prevent concrete and other materials from entering sleeve. Pipe penetrations shall be as follows:

1. New floors on grade: Provide sleeved penetrations for all piping except piping two inches and less and waste, drain, and vent piping. Piping not requiring sleeves shall be provided with 30 lb. asphalt saturated roofing felt wrapped around pipe through the thickness of the floor with concrete floor placed up to roofing felt.
2. New floors above grade: Provide sleeved penetrations for all piping.
3. Existing Floors Above Grade: Provide core-drilled penetrations for all piping.
4. New and Existing Walls: Provide sleeved or core drilled penetrations for all piping.
5. Floor type drains, cleanouts, and water closet waste connections do not require sleeved or core drilled penetrations. Concrete shall be placed tight to connection.
6. Roof penetrations through metal roofs by the Plumbing or Mechanical Contractor will be required to have written approval by the Roofing Contractor.

H. Pipe Sleeves: Install in accordance with the following:
1. Install sheet metal on steel pipe sleeves in interior walls.
2. Install steel pipe sleeves in interior floors above grade.
3. Install galvanized steel pipe sleeves in floors on grade and in exterior walls above grade and below grade.

I. Penetration Seals:
1. Install mineral wool/oakum seals as follows:
   a. In interior walls where piping passes from one space to another, where any one of the spaces the piping penetration is not concealed by a ceiling. Caulk penetration watertight.
2. Install mechanical seals in accordance with manufacturer's recommendations as follows:
   a. In interior floors on grade.
   b. In interior floors above grade, use three-hour fire rated type only.
   c. In exterior walls above grade and below grade.
   d. In all roof penetrations except vent piping, flue piping, roof or overflow drain piping or any other piping as otherwise detailed on Drawing.
3. Install fire barrier seals in accordance with manufacturer's recommendations as follows:
   a. In all floors above grade, roofs and fire rated walls.

END OF SECTION

SECTION 23 00 10
BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS AND SUPPLEMENTAL GENERAL PROVISIONS

A. The "General Conditions" and "Supplementary Conditions" are by reference made a part of this section and shall apply to each and every heading as though included herein.

B. In the event of conflict, the requirements of the "General Conditions" and "Supplementary Conditions" will take precedence over these "General Requirements".

1.2 GENERAL

A. The Contractor shall provide all plans, labor, equipment, appliances and materials, and shall perform all operations in connection with the installation of the mechanical work in accordance with the Specifications, applicable drawings, and the conditions specified above.

B. Contractor shall provide all equipment required and usually furnished in connection with such work and systems whether or not specifically mentioned or specifically indicated on the drawings.

1.3 COMMISSIONING

A. The Contractor shall provide all system commissioning services as required by section C408 of the applicable edition of the International Energy Conservation Code (IECC). Mechanical systems shall comply with IECC section C403.

B. Commissioning, as outlined in IECC section C408 shall include the following:

1. A commissioning plan.
2. Air systems balancing.
3. Functional performance testing for all mechanical equipment, controls and economizers.
4. A preliminary commissioning report.
5. Final documentation including drawings, O&M manual(s), T&B report, and final commissioning report.

C. Per the 2021 IECC the Mechanical System and Service Hot Water System Commissioning is not required when cooling equipment capacity is less than 480,000 Btuh (40 Tons) and the combined Space Heating and Service Hot Water System heating capacity is less than 600,000 Btuh (50 Tons).

1.4 INSPECTION OF THE SITE

A. The Contractor shall visit the site, verifying all existing items indicated on drawings and/or specified, and familiarize himself with the existing work conditions, hazards, grades, actual formations, soil conditions, and local requirements. The submission of bids shall be deemed evidence of such visits.

B. All proposals shall take these existing conditions into consideration, and the lack of specific information on the drawings shall not relieve the Contractor of any responsibility.

C. In the event that equipment specified and/or reviewed is not compatible with the existing conditions, the trade furnishing the equipment shall be responsible for notifying the Contractor prior to ordering it.

1.5 PERMITS, UTILITY CONNECTIONS, AND INSPECTIONS

A. Refer to other sections of the specifications for construction phasing and time increments.

B. The Contractor shall obtain and pay for all required utility connections, utility extensions and/or relocations and shall pay all costs and inspection fees for all work included herein.

1.6 APPLICABLE CODES AND STANDARDS

A. The installation shall meet the minimum standards prescribed in the latest editions of the following listed codes and standards, which are made a part of the Specifications, except as may be hereinafter modified in these Specifications and associated drawings.

B. Latest edition of the National Fire Protection Association Standards (NFPA):

1. NFPA No. 70 National Electrical Code
2. NFPA No. 90A Installation of Air Conditioning and Ventilating systems
3. NFPA No. 91 Exhaust systems of Air Conveying of Gases, etc.
4. NFPA No. 96 Ventilation control and Fire Protection of Commercial Cooking Operations
5. NFPA No. 101 Safety to Life from Fire in Buildings and Structures
6. NFPA No. 255 Test of Surface Burning Characteristics of Building Materials

C. United States of America Standards Institute (ASA) Standards:

1. A40.8 National Plumbing Code
2. B31.1 & B31.1a Code for Pressure Piping

D. American Society of Mechanical Engineers (ASME): Boiler and Pressure Vessel Codes.

E. Air Conditioning and Refrigeration Institute Standards (ARI): All standards related to refrigeration and air conditioning equipment and piping furnished under these Specifications.

F. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) 1985: All applicable manuals and standards.

G. Air Moving and Conditioning Association (AMCA): All applicable manuals and standards.

H. American Society of Testing and Material (ASTM): All applicable manuals and standards.

I. American Water Works Association (AWWA): All applicable manuals and standards.

J. National Electrical Manufacturer's Association (NEMA): All applicable manuals and standards.

K. City Fire Department as applicable to construction of this site.

L. City and State Building Codes.

M. State of (Texas) Occupational Safety Act: Applicable safety standards.

N. Occupational Safety and Health Act (OSHA).

O. State of (Texas) Energy Conservation Construction Code.

P. All work shall be in accordance with all regulations and requirements of the State of Texas Architectural Barriers Act (TAS).

Q. Refer to Specifications sections hereinafter bound for additional codes and standards.

R. All materials and workmanship shall comply with all applicable state and national codes, specifications, and industry standards. All material shall be listed by the Underwriter's Laboratories, Inc., as conforming to its standards and so labeled in every case where such a standard has been established for the particular type of material in question.

S. All equipment provided and all installation methods shall meet all applicable requirements of the International Energy Conservation Code.

T. The Contract Documents are intended to comply with the aforementioned rules and regulations; however, some discrepancies may occur. Where such discrepancies occur, the Contractor shall immediately apply for an interpretation. Should the discovery and notification occur after the execution of a contract, any additional work required for compliance with said regulations shall be paid for as covered by other specifications of the Contract Documents, providing no work or fabrication of materials has been accomplished in a manner of non-compliance. Should the Contractor fabricate and/or install materials and/or workmanship in such a manner that does not comply with the applicable codes, rules and regulations, the Contractor who performed such work shall bear all costs arising in correcting these deficiencies to comply with said rules and regulations.

1.7 CONTRACT DOCUMENTS

A. These specifications are accompanied by drawings of the building and details of the installations indicating the locations of equipment, piping, ductwork, outlets, switch controls, circuits, lines, etc. The drawings and these specifications are complementary to each other, and what is required by one shall be as binding as if required by both.

B. If the Contractor deems any departures from the drawings necessary, details of such departures and the reasons therefore shall be submitted to the Architect for review. No departures shall be made without prior written acceptance.

C. There are intricacies of construction that are impractical to specify or indicate in detail; however, in such cases the current rules of good practice and applicable specifications shall govern.

D. It is the Contractor's responsibility to properly use all information found on the Civil, Architectural, Structural, Mechanical, Plumbing, Fire Protection, and Electrical drawings where such information affects his work.

E. All dimensional information related to new structures should be taken from the appropriate drawings. All dimensional information related to existing facilities shall be taken from actual measurements made by the Contractor on the site.

F. The interrelation of the specifications, the drawings, and the schedules is as follows: The specifications determine the nature and setting of the several materials, the drawings establish the quantities, dimensions and details, and the schedules give the performance characteristics.

G. Should the drawings or specifications disagree within themselves, or with each other, the better quality of greater quantity of work or materials shall be estimated upon, and unless otherwise directed by the Architect in writing, shall be performed or furnished. Figures indicated on drawings govern scale measurements and large-scale details govern small-scale drawings.

1.8 SPACE AND EQUIPMENT ARRANGEMENT

A. The size of fire protection, plumbing, 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. Shop drawings shall be prepared to indicate a suitable arrangement.

B. 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.

C. Maintain all code required clearances for equipment access.

1.9 FABRICATION DRAWINGS

A. Contractor shall submit ductwork fabrication and hydronic piping shop drawings for review by the Architect. Fabrication drawings shall be fully coordinated with ALL other trades and with existing conditions.

B. All required shop drawings, except as hereinafter specified, shall be prepared at a scale of not less than 1/8 in. equal to 1 ft. for floor plans and 1/4 in. equal to 1 ft. for mechanical rooms.

1.10 SUPERVISION

A. Each contractor shall keep a competent superintendent or foreman on the job at all times necessary for the timely and proper completion of the work.

B. It shall be the responsibility of each superintendent to study all drawings and familiarize himself with the work to be done by other trades. He shall coordinate this work with other trades, and before material is fabricated or installed, make sure that his work will not cause an interference that cannot be resolved without major changes to the drawings. If a conflict between trades arises that cannot be resolved at the jobsite, the matter shall be referred to the Architect for his ruling.

1.11 EXISTING FACILITIES

A. The Contractor shall be responsible for loss or damage to the existing facilities caused by him and his workmen, and shall be responsible for repairing or replacing such loss or damage. The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection and in-service maintenance of all plumbing, heating, air conditioning, and ventilating services for the new and existing facilities. The Contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, and remove all such temporary protection upon completion of the work. All barricades and safety devices shall be in compliance with OSHA.

B. The Contractor shall provide temporary or new services to all existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.

C. Where existing construction is removed to provide working and extension access to existing utilities, Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air conditioning ductwork and equipment, etc., to provide this access and shall reinstall same upon completion of work in the areas affected.

D. Where partitions, walls, floors, or ceilings of existing construction are indicated to be removed, all Contractors shall remove and reinstall, in locations approved by the Architect, all devices required for the operation of the various systems installed in the existing construction. This is to include, but is not limited to, temperature control system devices, electrical switches, relays, fixtures, piping, conduit, etc.

E. Outages of services, as required by the new installation, will be permitted only at a time approved by the Architect.

1.12 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. 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.

B. All items that 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. 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 and sealed, capped, or otherwise tied-off or disconnected in a safe manner acceptable to the Architect. 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 of facilities, which must remain in operation during the construction period, shall not be interrupted without prior specific approval of the Architect as hereinbefore specified.

D. All equipment and materials indicated to be removed and not be re-used shall be disposed of by the Contractor. Coordinate with Owner where materials are to be stored.

1.13 OPERATING AND MAINTENANCE INSTRUCTIONS

A. The Contractor shall prepare, in triplicate for the Owner's Manual, complete sets of operating and maintenance instructions, system piping, valving, control and interlock diagrams, manuals, parts lists, etc., for each item of equipment. Include copies of all equipment warranties.

B. In addition, the Contractor shall provide the services of a competent engineer or a technician acceptable to the Architect to instruct a representative of the Owner in the complete and detailed operation of all equipment and systems. These instructions shall be provided for a period of not less than 4 hours to fully accomplish the desired results. Upon completion of these instructions, a letter of release will be required, stating the dates of instruction and the personnel to whom instructions were given. The Contractor shall be responsible for proper maintenance until the instructions have been given to the Owner's maintenance personnel.

1.14 GUARANTEE

A. All work and equipment shall be guaranteed for a period of one year from the date of substantial completion.

B. Guarantee shall be for all labor and materials.

C. Certain items for equipment shall have additional or extended warranties when so specified.

1.15 MATERIALS AND WORKMANSHIP

A. All materials, unless otherwise specified, shall be of current U.S. manufacture, new, free from all defects, and of the best quality of their respective kinds. Materials and equipment shall be installed in accordance with the manufacturer's recommendations and the best standard practice for the type of work involved. All work shall be executed by mechanics skilled in their respective trades, and the installations shall present a neat, workmanlike appearance. Materials, and/or equipment damaged in shipment, or otherwise damaged prior to installation, shall not be repaired at the job site, but shall be replaced with new materials and/or equipment.

B. The responsibility for furnishing the proper equipment and/or material, and to see that it is installed as intended by the manufacturer rests entirely upon the Contractor, who shall request advice and supervisory assistance from the representative of specific manufacturers during the installation.

1.16 FLAME SPREAD PROPERTIES OF MATERIALS

A. Materials and adhesives incorporated in this project shall conform to NFPA 255, latest edition. The classification shall not exceed No. 2, with the range of indices between 0 to 25 for these Classifications as listed in the Federal Specifications. Modifications shall be made to insulating materials, etc., as required to comply with the Federal Specification.

1.17 LARGE APPARATUS

A. Any large piece of apparatus which is to be installed in any space in the building, and which is too large to permit access through stairways, doorways, or shafts shall be brought to the job and placed in the space before the enclosing structure is completed. Following placement in the space, such apparatus shall be thoroughly, completely protected from damage as hereinafter specified.

1.18 FLOOR AND CEILING PLATES

A. Except as otherwise noted, provide chrome plated brass floor and ceiling plates around all pipes, conduits, ducts, etc., passing exposed through walls, floors, or ceilings, in any spaces, except under floor and attic spaces. Plates shall be sized to fit snugly against the outside of the pipe or against the insulation on lines that are insulated and positively secured to such pipe or insulation. Plates will not be required for piping where pipe sleeves extend 3/4 in. above finished floor. All equipment rooms are classified as finished areas. Round and rectangular ducts shall have plates made to fit accurately at all floor, wall and ceiling penetrations.

1.19 SLEEVES, INSERTS AND FASTENINGS

A. Proper openings through floors, walls, roofs, etc., for the passage of piping, ductwork, etc., shall be provided. All penetrations must pass through sleeves except soil pipe installed under concrete slabs on fill. Sleeves shall be set in new construction before concrete is poured, as cutting holes through any part of the concrete will not be permitted unless acceptable to the Architect.

B. Pipes passing through concrete or cinder walls and floor or other corrosive material shall be protected by a protective sheathing or wrapping or by sleeves, as required to meet the local code. Annular spaces between sleeves and pipes shall be filled or tightly caulked in an approved manner. Annular spaces between sleeves and pipes in fire-resistance-rated assemblies shall be filled or tightly caulked in accordance with the local code.

C. The minimum clearance between horizontal penetrations including insulation where applicable, and sleeves shall be 1/4 in., except that the minimum clearance shall be 2 in. where piping contacts the ground. Sleeves through walls and partitions shall be installed flush with exposed surfaces. Sleeves through floors shall be extended 2 in. above finished floor.

D. Above grade and dry location sleeves shall be constructed from 20 to 22 gauge galvanized steel. Sleeves passing through walls or floors on or below grade and/or moist areas such as mechanical rooms shall be constructed of galvanized steel Schedule 40 pipe and shall be designed with suitable flange in the center of the floor or wall to form a waterproof passage. After the pipes have been installed in the sleeves, void space around the pipe shall be sealed with "Link-Seal" modular wall and casing seals as manufactured by Thunderline Corporation.

E. Suitable concrete inserts for pipe and equipment hangers shall be set and properly located for all pipe and equipment to be suspended from concrete construction.

F. Fastening of pipes, conduits, etc., in the building shall be as follows: To wood members - by wood screws; to masonry - by threaded metal inserts, metal expansion screws, or toggle bolts, whichever is appropriate for the particular type of masonry; to steel - machine screws or welding (when specifically permitted or directed), or bolts, and to concrete by suitable inserts anchored to reinforcing steel, and poured in place unless other means are acceptable for general use, and will only be permitted where specifically acceptable to the Architect.

G. Under no circumstances will the use of plastic anchors or plastic expansion shields be permitted for any purpose whatsoever.

H. Vermin Proofing: The open space around all ductwork, piping, etc., passing through the ground floor and/or exterior walls shall be sealed with a continuous bead of sealant.

I. The space around piping, ductwork, etc., penetrating walls, ceilings and floors that define air plenums shall be sealed airtight in an acceptable manner. Ceiling plenums used for return air are considered air plenums.

1.20 ACCESS DOORS

A. This Contractor shall provide wall or ceiling access doors for unrestricted access to all concealed shutoff or service valves, strainer, unions, pressure reducing valves, trap primers, water hammer arrestors, heat trace cable junction boxes, and other items of concealed mechanical equipment. All access door locations are not shown on the drawings. It is the Contractor's responsibility to provide access doors at all locations required.

B. Access doors mounted in painted surfaces shall be equal to Milcor (Inland-Ryerson Construction Products Company) manufacture, 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 minimum of 18 in. x 18 in. in size.

1.21 CONSTRUCTION REQUIREMENTS

A. The Civil, Architectural, Structural, Fire Protection, Mechanical, Plumbing, and Electrical plans and specifications including the General Provisions, Supplemental General Provisions, and other pertinent documents issued by the Architect, are a part of these specifications and the accompanying mechanical drawings, and shall be complied with in every respect. All the above is included in the Contract Documents, and shall be examined by all bidders. Failure to comply shall not relieve the Contractor of responsibility or be used as a basis for additional compensation due to omission of architectural, structural and electrical details from the mechanical drawings.

B. It is the intent of the Contract Documents to provide an installation complete in every respect. In the event that additional details or special construction may be required for work indicated or specified in this section or work specified in other sections, it shall be the responsibility of the Contractor to provide same as well as to provide material and equipment usually furnished with such systems or required to complete the installation, whether mentioned or not.

C. 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 supplied by the manufacturer of the equipment to be installed and thereby to provide an integrated satisfactory operating installation.

D. The mechanical and associated drawings are necessarily diagrammatic in character and cannot show every connection in detail or every pipe or equipment in its exact location. These details are subject to the requirements of ordinances and also 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 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. Work shall be installed to avoid crippling of structural members; therefore, inserts to accommodate pipe hangers shall be set before concrete is poured, and proper openings through floor, walls, beams, etc., shall be provided as hereinafter specified or as otherwise indicated or required. All work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.

E. When the mechanical drawings do not give exact details as to the elevation of pipe, ducts, etc., physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Piping and 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, and the plans do not show all required offsets, control lines, pilot lines and other location details. Work shall be concealed in all finished areas. Piping specified to be insulated shall be supported in a manner that will allow the insulation to be installed without gaps. Insulated piping in concealed areas shall be offset with fittings as necessary to permit installation of insulation. Bending of pipes or installing pipes in a strain in order to insulate will not be permitted.

F. All oiling devices and all parts of equipment requiring adjustment shall be easily accessible. Equipment shall be so located and installed as to permit convenient and safe maintenance and future replacement. Piping, ductwork, valve stems, etc., shall not block service space.

1.22 MECHANICAL SUBMITTALS AND SHOP DRAWINGS

A. Definitions:

1. Submittal - Equipment, Product Data, and Material Information for components proposed to be installed for the project.
2. Shop Drawing - Scaled floor plans, riser or isometric diagrams, and elevations of proposed components to be installed for the project.

B. Refer to the Conditions of the Contract (General and Supplementary) and Division 01 Section: "SUBMITTALS" for submittal definitions, requirements, and procedures.

C. Submittals and Shop Drawings will be accepted only when submitted by the Contractor. Data submitted from Subcontractors and material suppliers directly to the Architect will not be processed.

D. Submit Submittals, product data, and samples on items indicated in the individual sections.

E. Submittals and Shop Drawings data shall not be used as requests or proposals for alternate equipment or materials. Refer to Item "Product Options and Substitutions" elsewhere in this section.

F. THIRD PARTY CERTIFICATION: All Packaged equipment shall be independently Third Party labeled as a system for its intended use by a Nationally Recognized Testing Laboratory (NRTL) in accordance with OSHA Federal Regulations 29CFR1910.303 and .399, as well as NFPA Pamphlet #70, National Electric Code (NEC), Article 90-7.

1.23 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Refer to the Instructions to Bidders and the Division 01 Section "SUBSTITUTION PROCEDURES" for requirements in selecting products and requesting substitutions.

B. Standards for Materials:

1. These specifications indicate a standard for all materials incorporated into the work, with manufacturer's names and catalog numbers used to establish a grade and quality of materials and equipment. The manufacturer listed on the equipment schedules, or named first in the specifications, is the one on whose equipment the layout is based. Other named manufacturers must meet the indicated performance and space requirements.

2. The "approved equal" clause used in these specifications is to permit the proposal of unnamed manufacturer's products for the work, and the Architect decision concerning equal products is final.

3. Considerations as to determination of equal products include, but are not limited to, the following:

Materials	Physical size
Workmanship	Weight
Gauges of Materials	Appearance
Available Local Service Personnel	Performance
Previous successful installations	Capacity
Delivery Schedules	Required Equipment Clearances

4. Shop Drawings must be submitted if proposed equipment differs in physical size than specified equipment to indicate proposed equipment has been coordinated with other trades and space allocated for this equipment. Shop Drawings must be at a 1/4" per foot scale indicating proposed equipment layout and any other equipment/materials noted in that general area. Other equipment may include, but is not limited to, HVAC equipment, plumbing equipment, electrical equipment, light fixtures, structural membersm cabinetry, etc.

5. Failure to submit scaled Shop Drawings will indicate that the Contractor has coordinated their efforts with other trades and finds no conflicts with the work presented in the Contract Documents.

C. Requests for substitutions for equipment, materials and apparatus listed in Division 23 Sections must be submitted in writing a **MINIMUM OF 10 DAYS** prior to the scheduled bid date. Such requests must be accompanied by complete data to permit proper evaluation.

D. BIDS SHALL NOT BE BASED ON UN-APPROVED MATERIALS, EQUIPMENT, OR APPARATUS. UNAPPROVED MATERIAL, EQUIPMENT OR APPARATUS WILL NOT BE ACCEPTED.

E. Should electrical, water, drain, natural gas, structural support, or other similar requirements for alternate equipment, whether named in the specifications or approved as a substitution, be different from requirements for the products used in laying out the project, such changes shall be the responsibility of the Contractor, and shall not result in extra charges to the Owner or Architect/Engineer.

1.24 RECORD DOCUMENTS

A. Refer to the Division 01 Section: "CLOSEOUT PROCEDURES" for requirements. The following paragraphs supplement the requirements of Division 01.

B. Mark Drawings to indicate revisions to piping and ductwork, size and location both exterior and interior; including locations of coils, dampers and other control devices, filters, boxes, and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned for column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.); Change Orders; concealed control system devices.

C. Mark Specifications to indicate approved substitutions; Change Orders; actual equipment and materials used.

1.25 PAINTING

A. Field painting of mechanical equipment, duct systems, piping systems, etc., shall be accomplished under Division 09 of these specifications.

B. Protection of Factory-applied Finishes:

1. Factory-applied finishes on equipment and apparatus installed on the project shall be carefully protected.
2. At the conclusion of the work, and prior to final acceptance of the project, equipment and apparatus shall be thoroughly cleaned of all construction dirt, oil and grease smears, temporary labels, debris, paint droppings, etc.
3. Damaged factory finishes shall be restored to their original condition using procedures, materials and application techniques as set forth in Division 09 found elsewhere in these specifications.

1.26 CLEANING

A. Refer to the Division 01 Section: "CLOSEOUT PROCEDURES" for general requirements for final cleaning.

B. Refer to Division 23 Section: "MECHANICALTESTING, ADJUSTING, AND BALANCING" for requirements for cleaning filters, strainers, and mechanical systems prior to final acceptance.

C. Name Plates:

1. All nameplates shall be protected from damage during the construction process.
2. At the conclusion of the work, the nameplates shall be carefully cleaned and left in a fully legible condition.

D. Removal of Rubbish: Each Contractor is responsible for the timely removal of rubbish and trash generated by his work, such as empty cartons, containers, materials crates, etc. Particular attention is called to residue that may present a potential tripping or injury hazard.

1.27 MOTORS AND DRIVES

A. Motors:

1. General: Motors shall be U/L-approved, with copper windings, and with a minimum Service Factor of 1.15. The nominal capacity shall exceed the brake horse-power requirements at duty schedules.
2. Motors 1/2 HP and smaller shall be 120-volt, single-phase with internal overload protection.
3. Motors 3/4 HP and larger shall be 208/230 or 460 -volt, 3-phase, unless scheduled or noted otherwise, and shall have thermal over-load cutouts in each phase as recommended by the motor manufacturer.
4. Motors shall be as manufactured by Century, General Electric, US Motors, Wagner, Westinghouse, or approved equal.

B. Drives:

1. Belts drives shall be rated for 150% of motor-rated horsepower.
2. Drive assemblies up to two (2) belts shall have adjustable motor sheaves with the mid-point of the adjustment range at the RPM required for the specified performance.
3. On drive assemblies with 3 or more belts, provide fixed motor sheaves for the specified RPM. Provide and install up to 2 pulley changes as necessary to achieve the required air quantities.
4. All multiple-belt drives shall be factory-marked-matched sets.

C. Specific requirements:

1. Provide high-efficiency motors for the following:
   a. Air-Handling Units, as scheduled.
   b. Ventilating Fans, as scheduled.
   c. HVAC Pumps, as scheduled.
2. Efficiency ranges shall be as follows:

Nominal HP	Minimum Efficiency	Premium Efficiency
3	86.5	89.5
5	87.5	89.5
7.5	88.5	91.7
10	89.5	91.7
15	91.0	92.4
20	91.0	93.0
25	91.7	93.6
30	92.4	93.6
40	93.0	94.1
50, 60, 75	93.0, 93.6, 94.1	94.5, 95.0, 95.4
100	94.1	95.4

3. Motor efficiency certification shall be included with Product Submittal Data in accordance with Division 01 of these specifications.
4. Variable Speed (Frequency) AC Drives:
    a. Where scheduled on the plans, provide and install variable speed (frequency) AC drives for motors.
    b. Variable speed (frequency) AC drives shall be as described in Section 23 89 65 - MOTOR CONTROLLERS of these Specifications.
5. Motor Starters and Controllers:
    a. Motor starters and controllers for fans, pumps, air-handling units, compressors, etc., which are not provided as an integral part of a factory-assembled package, shall be provided under Division 23 of the specifications. Refer to Section 23 89 65 - MOTOR CONTROLLERS.

PART 2 - PRODUCTS

2.1 GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS

A. The manufacturer's published instructions shall be followed for preparing, assembling, installing, erecting, and cleaning manufacturer's materials or equipment, unless otherwise indicated. 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.

B. The Contractor shall not receive material or equipment at the jobsite until there is suitable space provided to properly protect equipment from rust, drip, humidity, and dust damage.

C. Capacities shall be not less than those indicated but shall be such that no component or system becomes inoperative or is damaged because of start-up or other overload conditions.

D. Where materials or equipment are specified to be approved, listed, tested, or labeled by the Underwriter's Laboratories, Inc., or constructed and/or tested in accordance with the standards of the American Society of Mechanical Engineers or the Air Moving and Conditioning Association, the Contractor shall submit proof that the items furnished under these sections of the specifications conform to such requirements. The ASME stamp or the AMCA label will be acceptable as sufficient evidence that the items conform to the respective requirements.

E. Each major component of equipment shall have the manufacturer's name, address, and catalog number on a plate securely attached to the item of equipment. All data on nameplates shall be legible at the time of Final Observation.

F. Standard factory finish will be acceptable on equipment specified by model number; otherwise surfaces of ferrous metal shall be given a rust-inhibiting coating. The treatment shall withstand 200 hours in salt-spray fog test, in accordance with Method 6061 of Federal Standard No. 141. Immediately after completion of the test, the specimen shall show no signs of wrinkling or cracking, and no signs of rust creepage beyond 1/8 in. on either side of the scratch mark. Where rust-inhibitor coating is specified hereinafter, any treatment that will pass the above test is acceptable, unless a specific coating is specified, except that coal tar or asphalt type coatings will not be acceptable, unless so stated for a specific item. Where steel is specified to be hot-dip galvanized, mill-galvanized sheet steel may be used provided all raw edges are painted with a zinc-pigmented paint conforming to Military Specification MIL-P-6215.

G. Belts, pulleys, chains, gears, couplings, projecting setscrews, keys and other rotating parts located so that any person can come in close proximity thereto, shall be fully enclosed or properly guarded.

H. The Contractor shall be responsible for the coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and thoroughly familiarize himself with all details of the work and working conditions, to verify all dimensions in the field, and to advise the Architect of any discrepancy before performing any work. Adjustments to the work required, in order to facilitate a coordinated installation, shall be made at no additional cost to the Owner.

2.2 PROTECTION

A. 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. Failure on the part of the Contractor to comply with the above will be sufficient cause for the rejection of the items in question.

B. Take particular care not to damage the building structure in performing work. All finished floors, steel treads, and workmen or their tools and equipment shall cover finished surfaces to prevent any damage during the construction of the building.

C. 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 observation must be cleaned of rust and repainted as specified elsewhere in these specifications.

2.3 COOPERATION BETWEEN TRADES AND WITH OTHER CONTRACTORS

A. Each trade, subcontractor and/or contractor must work in harmony with the various other trades, subcontractors, and/or contractors on the job as may be required to facilitate the progress to the best advantage of the job as a whole. Each trade, subcontractor, and/or contractor must pursue his work promptly and carefully as not to delay the general progress of the job. This Contractor shall work in harmony with contractors working under other contracts on the premises.

2.4 PRECEDENCE OF MATERIALS

A. These specifications and the accompanying drawings are intended to cover systems which will not interfere with the structural design of the building, which will fit into the available space, and which will insure complete and satisfactory systems. Each Contractor shall be responsible for the proper fitting of his material and apparatus into the building.

B. Each Contractor shall so harmonize his work with that of the other trades so that it may be installed in the most direct and workmanlike manner without hindering or handicapping the other trades. Piping interferences shall be handled by giving precedence to pipelines that require a stated grade for proper operation. Where space requirements conflict, the following order of precedence shall, in general, be observed:

1. Building lines
2. Structural members
3. Soil and drain piping
4. Vent piping
5. Condensate piping
6. Refrigerant piping
7. Electrical bus duct
8. Supply ductwork
9. Return ductwork
10. Exhaust ductwork
11. Chilled water and heating water piping
12. Automatic Fire Protection Sprinkler Piping
13. Natural gas piping
14. Domestic hot and cold water piping
15. Electrical conduit

2.5 LOCATION OF OUTLETS IN ROOMS

A. All fire protection, plumbing, acoustical tile, diffusers, grilles, registers, and other devices shall be referenced to coordinated, established data points and shall be located to present symmetrical arrangements with these points and to facilitate the proper arrangements of acoustical tile panels and other similar panels with respect to the mechanical and electrical outlets and devices. Those mechanical and electrical outlets shall be referenced to such features as wall and ceiling furrings, balanced border widths, masonry joints, etc. Outlets in acoustical tile shall occur symmetrically in tile joints or in the center of whole tiles. When locations of mechanical and electrical devices shown on the Architect reflected ceiling plans need to be modified, 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 diagrammatically the location of the various outlets and apparatus. Exact locations of these outlets and apparatus shall be determined by reference to the general 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 apparatus before installation, without additional cost to the Owner.

C. The Contractor, by submitting a bid on this work, sets forth that he has the necessary technical training and ability, and that he will install his work in a satisfactory and workmanlike manner which is up to the best standards of the trade, complete, and in good working order. If any of the requirements of the drawings and specifications are impossible of performance, or if the installation, when made in accordance with such requirements, will not perform satisfactorily, he shall report it to the Architect for correction promptly after discovery of the discrepancy.

2.6 CONNECTIONS FOR OTHERS

A. This Contractor shall rough-in for and make all gas, water, steam, sewer, etc., connections to all fixtures, equipment, machinery, etc., provided by others in accordance with detailed roughing-in drawings provided by the equipment suppliers, along with 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 where required. In each water line serving an item of equipment or piece of machinery, provide a shut-off valve. On each drain not provided with a trap, provide a suitable trap.

D. All pipefittings, 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 sheet metal ductwork, transition pieces, etc., required for a complete installation of vent hoods, exhaust hoods, etc., provided by others.

2.7 SMOKE DETECTORS

A. The contractor shall for each air handling system with 2000 CFM (nominal 5 Tons) or greater airflow, install UL-listed ionized smoke detectors in the main supply air duct and main return air duct and/or where shown on the drawing. Smoke detectors furnished by Division 26. Refer to Section 23 05 12. Connect the detectors into the control circuit to stop the fan in the event of the presence of smoke.

1. System airflow included the total airflow of all units serving any single space and all units connected to the same return air plenum.

PART 3 - INSTALLATION

3.1 INSTALLATION METHODS

A. All pipes shall be concealed in pipe chases, walls, furred spaces, or above the ceiling, unless otherwise indicated.

B. Piping may be run exposed in mechanical rooms, janitors' closets, or storage spaces, but only where necessary. All exposed piping shall be run in the neatest, most inconspicuous manner, and parallel or perpendicular to the building lines.

C. All piping shall be adequately and properly supported from the building structure by means of hanger rods or clamps to walls as herein specified.

D. Where limited space is available above the ceilings and below concrete beams or other deep projections, pipe and conduit shall be sleeved through the projection where it crosses, in a manner to provide maximum above-floor clearance. Sleeves shall be as specified or as required.

E. All pipe, conduits, etc., shall be cut accurately to measurements established at the building and shall be worked into place without springing or forcing. All ducts, pipes and conduits run, exposed in machinery and equipment rooms, shall be installed parallel to the building plans, except as otherwise shown. Conduits in furred ceilings and in other concealed spaces may be run at angles to the construction but shall be neatly grouped and racked indicating good workmanship. All conduit and pipe openings shall be kept closed until the systems are closed with final connections.

F. There shall be no pipe joints nearer than 12 in. to a wall, ceiling, or floor penetration, unless pipe joint is the welded type joint.

G. The Contractor shall study all construction documents and carefully lay out all work in advance of fabrication and erection in order to meet the requirements of the extremely limited spaces. Where conflicts occur, the Contractor shall meet with all involved trades and the Architect and resolve the conflict, prior to erection of any work, in the area involved.

3.2 CUTTING AND PATCHING

A. Cut and patch openings through walls, floors, etc., resulting from work in existing construction or by failure to provide proper openings or recesses in new construction.

B. Openings cut through concrete and masonry shall be made with masonry saws and/or core drills at locations acceptable to the Architect. Impact-type equipment will not be used, except where specifically acceptable to the Architect. Openings in Precast concrete slabs for pipes, conduits, outlet boxes, etc., shall be core drilled or cast to exact size.

C. All openings shall be restored to "as-new" condition under the appropriate Specification Section for the materials involved, and shall match remaining surrounding materials and/or finishes.

D. 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.

E. All mechanical work in areas containing plaster shall be completed prior to the application of the finish plaster coat. Cutting of finish plaster coat will not be permitted.

F. No cutting, boring, or excavating, which will weaken the structure, shall be undertaken. NO STRUCTURAL MEMBER MAY BE CUT WITHOUT THE WRITTEN APPROVAL OF THE ARCHITECT.

3.3 ROOF PENETRATIONS AND FLASHING

A. Pipe and duct sleeves and flashings compatible with the roofing installation shall be provided for roof penetrations. Manufacturer of roofing materials shall approve methods and materials. Pitch pans are not acceptable.

B. Roof penetrations through metal roofs by the Plumbing or Mechanical Contractor will be required to have written approval by the Roofing Contractor.

C. Piping penetration flashings shall be specially made for metal roofs and shall be EPDM or neoprene compression molded rubber with corrosion resistant metal base. Flashings shall be by Portals Plus, Inc., Buildex Dektite, or approved equal.

3.4 FABRICATION OF PIPE

A. All the various piping systems shall be made up straight and true and run at proper grades to permit proper flow of the contained material. Lines shall also be graded for proper drainage.

B. Piping shall follow as closely as possible the routes shown on plans, but shall take into consideration conditions to be met at the site.

C. Should any unforeseen conditions arise, lines shall be changed or rerouted as required after approval has been obtained.

D. All piping shall be installed with due regard to expansion and contraction and so as to prevent excessive strain and stress in the piping, in connections, and in equipment to which lines are connected.

E. All piping shall be clean when it is installed. Before installation it shall be checked, upended, swabbed, if necessary, and all rust or dirt from storage shall be removed. Pipe shall not be permitted to lie on the ground during storage. Pipe ends shall be sealed during storage.

3.5 IDENTIFICATION AND LABELING

A. The Contractor shall make it possible for the personnel operating and maintaining the equipment and systems in this project to readily identify the various pieces of equipment, valves, piping, etc., by marking them.

B. All items of mechanical and electrical equipment shall be identified by the attachment of engraved nameplates constructed from laminated phenolic plastic, at least 1/16 in. thick, 3-ply, with black surfaces and white core. Engraving shall be condensed gothic, at least 1/2 in. high, appropriately spaced. Nomenclature on the label shall include the name of the item, its mark number, area, space, or equipment served, and other pertinent information. Equipment to be labeled shall include, but not be limited to, the following:

1. Rooftop units
2. Air Handling Units
3. Furnaces
4. Exhaust Fans
5. Vent Fans
6. Roof mounted fans
7. Condensing Units
8. Heat Pumps

9. Circulating Pumps
10. Air conditioning control panels and switches
11. Motor controllers
12. Miscellaneous similar and/or related items.

C. The Contractor shall install identification tags to be affixed to those valves that have functions that are not obvious. For example, it would not be expected that valves at a pressure reducing station in a machine room would be tagged. The valve identification tags shall be brass discs, 2 in. in diameter. Each tag shall be attached to its valve with copper clad annealed iron wire or other approved material.

3.6 TESTS AND INSPECTIONS

A. The Contractor shall, during the progress of the work and upon its completion, test his work and make all tests as required by the specifications, state, municipal and other authorities having jurisdiction of the work. Piping pressure tests shall be made before pipe is concealed or covered. Tests shall be made in the presence of authorities requiring tests. The Contractor shall pay all costs, inspection charges and fees required for the tests of his work.

B. The Contractor shall provide all apparatus, temporary piping connection, etc., required for tests. The Contractor shall take all due precautions to prevent damage to the building or its contents incurred by such tests. The Contractor shall repair and make good at his own expense any damage caused by failures or leaks during the tests.

C. Leaks, defects or deficiencies shall be repaired and/or replaced, and tests shall be repeated until the test requirements are complied with fully.

D. All equipment shall be placed in operation and tested for proper automatic control before the final balancing of the system is started.

E. All tests shall have pertinent data logged by the Contractor at the time of testing. Data shall include date, time, personnel, description, and extent of system tested, test condition, test results, specified results, and any other pertinent data. Data shall be delivered to the Architect.

3.7 COOPERATION AND CLEANUP

A. It shall be the responsibility of each trade to cooperate fully with the other trades on the job to help keep the job site in a clean and safe condition. At the end of each day's work, each trade shall properly store all of his tools, equipment and materials and shall clean his debris from the job. Upon the completion of the job, each trade shall immediately remove all of his tools, equipment, any surplus materials and all debris caused by his portion of the work.

3.8 CLEANING AND PAINTING

A. All equipment, piping, ductwork, grills, insulation, etc., in finished areas furnished and installed by the Contractor shall be painted. Finished areas include mechanical rooms, boiler rooms, and outside the building as well as occupied areas inside the building. Final painting is to be done by the General Contractor. This Contractor shall thoroughly clean all part of materials and equipment of cement, plaster, and other 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 steel brushes to remove rust and other spots and left smooth and clean.

B. This Contractor shall thoroughly clean the finish on all parts of the materials and equipment with factory applied finishes. Exposed parts in equipment rooms, above crawl space slabs, and all other spaces except sealed chases and attics shall be thoroughly cleaned of cement, plaster and other materials, and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all cracks and corners scraped out. If the finish has been damaged, the Contractor shall re-paint to the satisfaction of the Architect.

C. All canvas finishes shall be painted with one sizing coat if not already sized, containing a mildew resistant additive and Arabol adhesive prior to any other specified finish paint.

D. No nameplates on equipment shall be painted, and suitable protection shall be afforded to the plates to prevent their being rendered illegible during painting operation.

3.9 ELECTRICAL PROVISIONS OF MECHANICAL WORK

A. The extent of electrical provisions to be provided as mechanical work is indicated in other mechanical sections of the specifications, on the drawings and as further specified in this section.

B. Starters, Controllers: In general, mechanical work includes furnishing combination starters. Controllers are specifically included as electrical work when mounted in motor control centers. Electrical work includes installation, mounting and wiring of starters and controllers that are furnished as mechanical work. Free standing, large motor controllers shall be set in place, on pads, as mechanical work.

C. Electrical heating equipment shall be furnished complete with internal or integral fusing and subdivision of loads to comply with the NEC.

D. Wherever possible, match the elements of the electrical provisions of mechanical work with similar elements of the electrical work specified in electrical sections of the specifications.

E. Standards:

1. For electrical equipment and products, comply with applicable NEMA standards, and refer to NEMA standards to definitions of terminology herein.
2. Comply with National Electrical Code (NFPA No. 70) for installation requirements.
3. Comply with National Electrical Contractors Association (NECA) "Standard of Installation".

3.10 TEMPORARY FACILITIES

A. Unless noted otherwise in the Supplementary General Conditions; provide temporary facilities.

3.11 EQUIPMENT INSTALLATION REQUIREMENTS

A. All mechanical equipment shall be furnished and installed complete and ready for use.

B. All mechanical equipment and appliances shall be installed in a manner that all Code required access and services space is provided. Coordinate exact position of equipment and appliances with routing of new ductwork and piping, and with all existing conditions to provide required clearances.

1. Ensure that a minimum of 30” deep and 30” wide working space is provided in front of the control side of each appliance and piece of air moving equipment.
2. Ensure that air moving equipment and appliance in attics are installed so that they also have Code required clear passageway.

C. Others shall furnish certain kitchen, lab, or Owner process equipment. Contractor shall be responsible for furnishing and installing all items as required to make kitchen equipment complete operating systems. The Contractor shall furnish and install all auxiliary piping, valves, controls, control wiring, conduit, alarms, etc., required. All necessary devices, control wiring, conduit, etc., will not necessarily be shown on the drawings.

3.12 EXCAVATION, BACKFILLING AND COMPACTION

A. Excavation:

1. Excavate to the depths required or as indicated.
2. Retain suitable sandy soil for backfilling.
3. Remove excess and non-suitable material.
4. Shore as necessary.
5. Excavate all materials encountered including rock and filled-in material.
6. Form sides where required.

B. Backfilling:

1. Do not backfill until all tests are complete and approved.
2. Backfill bottom of trench in 6 in. layers using sandy fill.
3. Place pipe on minimum bed of 6 in. sand.
4. Backfill around pipe and minimum of 12 in. above pipe with sand.

C. Compaction:

1. Compact backfill to 95% maximum density for cohesionless soils.

3.13 OWNER FURNISHED EQUIPMENT

A. The Contractor’s responsibility shall include receiving and installing all Owner-furnished equipment.

END OF SECTION

SECTION 23 05 06

MECHANICAL DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Demolition of:

1. Ductwork.
2. Grilles, registers, and diffusers.
3. Plumbing fixtures and trim, specialties, equipment and associated piping.
4. Fire protection equipment and associated piping.
5. Hanger and support devices.
6. All other appliances or devices associated with equipment or devices to be removed.

B. Demolition of all power wiring and conduit from each mechanical item to be removed back to the point of supply.

1.2 QUALITY ASSURANCE

A. Perform all demolition and removal work necessary to arrive at the arrangement shown on the Contract Drawings.

B. Perform all operations in such a method to cause minimum damage to items to be relocated, salvaged, or to remain intact and in use.

1.3 JOB CONDITIONS

A. Perform site repair and removal of salvaged items at times approved by the Owner. Accomplish repair and removal of items in a continuous and diligent manner in order to limit interference with Owner's on-going operations.

B. Drawings may not indicate and specifications may not identify every item required to be moved or removed.

C. Before submitting bids, visit and examine the site of the work and become familiar with the scope of the work and the details of the demolition work to be accomplished.

D. Submittal of a bid will be evidence that such an examination has been made and the various details noted.

E. Claims for extra compensation because of additional labor, materials, or equipment required because of difficulties encountered, will not be recognized unless items were concealed at time of inspection of the Contract Documents. Bring all such items to the attention of the Owner's Representative and the Architect for their disposition before continuing with the work.

F. Execute demolition work in a manner to protect adjacent equipment and other existing items against damage.

G. Provide and erect lights, barricades, warning signs, and other items as required for protection of the Owner's employees, building occupants, and the public.

H. Maintain barricades in good condition throughout the project to substantial completion.

I. Control the dust resulting from demolition to prevent it from spreading the occupied areas of the building and to avoid creating a nuisance in the immediate surrounding area.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 PROTECTION

A. Provide protection for all building elements, all items which are to remain, all occupants and all workers at all times, and in accordance with all requirements of the Owner.

3.2 PROTECTION OF BUILDING FROM THE WEATHER

A. Maintain weather protection for the space(s) being worked in at all times, and in accordance with all requirements of the Owner.

3.3 DEMOLITION

A. Perform demolition in accordance with all requirements of the Owner.

3.4 DISPOSITION OF MATERIALS

A. Dispose of all demolition items and materials in a legal off-site location.

3.5 RELOCATION AND REUSE OF MECHANICAL ITEMS

A. Relocate items indicated on the Contract Drawings as required to accommodate the new construction. Remove, relocate and reconnect equipment and accessories that are to be reused.

B. Coordinate the work with the Electrical Contractor. Determine which items and equipment are to remain, to be relocated or to be removed. Perform the work consistent with the scope of the project.

C. Transport and store materials removed and designated for relocation as directed by the Owner's Representative.

D. Remove all salvage items not be reused or delivered to the Owner, from the property at the end of each workday.

E. Maintain full water, drain, electrical service, etc., to all equipment and apparatus that remains in service in the building.

3.6 CLEANING

A. Section 23 00 10 - Basic Mechanical Requirements.

3.7 REMOVAL OF WATER

A. Be responsible for the removal of water in areas in which scheduled work is to be performed.

1. Remove water by pumping, siphoning, absorbent mopping, or compressed air brooming.
2. Do not use any method of removal that will cause damage to new or reused adjacent equipment or materials.

3.8 SCHEDULING

A. Schedule demolition in strict compliance with the instructions.

3.9 DISCONNECTION AND RECONNECTION OF UTILITIES

A. Do not disconnect or reconnect any utilities until notifying the Owner's Representative.

B. Notify the Electrical Contractor when requiring Electrical Disconnect or Reconnect.

END OF SECTION

SECTION 23 05 12

MECHANICAL AND ELECTRICAL COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Refer to Section 26 05 10 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK.

B. Refer to Section 21 00 10 - BASIC FIRE PROTECTION REQUIREMENTS.

C. Refer to Section 22 00 10 - BASIC PLUMBING REQUIREMENTS.

D. Refer to Section 23 00 10 - BASIC MECHANICAL REQUIREMENTS.

1.2 SUMMARY

A. This Section describes the coordination between the Fire Protection, Plumbing, Mechanical and Electrical portions of the work.

B. This Section is included under the Division 21 portion of the Specifications as Section 21 05 12, under the Division 22 portion of the Specifications as Section 22 05 12, under the Division 23 portion of the Specifications as Section 23 05 12, and under the Division 26 portion of the Specifications as Section 26 05 12.

1.3 WORK INCLUDED

A. Responsibility: Unless otherwise indicated, motors and controls shall be furnished, set in place and wired in accordance with the following schedule. **This schedule may include equipment and systems that are not required for this project. Only the equipment and systems that are required on the drawings and/or specified elsewhere will be required by this section:**

1.	Equipment Motors	21/22/23	21/22/23	26
2.	Magnetic Motor Starters			
	a. Automatically controlled, with or without HOA switches	21/22/23	26	Notes 1,3,5
	b. Automatically controlled, with or without HOA switches and furnished as part of	21/22/23	22/23	Notes 1,3,5

	factory wired equipment			
	c. Manually controlled	21/22/23	26	Notes 1,3,5
	d. Manually controlled and furnished as part of factory wired equipment	21/22/23	26	Notes 1,3,5
	e. Furnished in Motor Control Centers	26	26	Notes 1,3,5
3.	Variable Speed (Frequency) AC Drives	22/23	26	Notes 1,4,5
4.	Line voltage thermostats, time clocks, etc., not connected to control panel systems	23	26	23
5.	Electric thermostats, time clocks, remote bulb thermostats, motorized valves, float controls, etc. which are an integral part or directly attached to ducts, pipes, etc.	22/23	22/23	22/23
6.	Temperature control panels and	23	23	23

	time switches mounted on temperature control panels			
7.	Motorized valves, motorized dampers, solenoid valves, EP and PE switches, etc.	23	23	Note 1
8.	Alarm bells furnished with equipment installed by Division 22 or 23	22/23	22/23	22/23
9.	Wiring to obtain power for control circuits, including circuit breaker	21/22/23	21/22/23	21/22/23
10.	Low voltage controls	21/22/23	21/22/23	21/22/23
11.	Fire protection system (sprinkler) controls	21	21	Note 8
12.	Fire and smoke detectors installed on mechanical units and in ductwork	28	23	Note 8
13.	All relays required for fan	23	23	Note 1

	shutdown, motorized dampers, smoke control devices, and other items integral with HVAC equipment to provide operation and control of HVAC equipment			
14.	Smoke dampers, and combination fire/smoke dampers	23	23	Note 7
15.	Boiler and water heater controls, boiler burner controls panels	22/23	22/23	22/23
16.	Pushbutton stations, pilot lights	22/23	22/23	22/23
17.	Heat Tape	21/22/23	21/22/23	26
18.	Disconnect switches, manual operating switches furnished as a part of the equipment	21/22/23	21/22/23	Notes 1,5
19.	Disconnect switches, manual operating switches furnished separate	26	26	26

	from equipment			
20.	Multispeed switches	23	23	26
21.	Thermal overloads	21/22/23	21/22/23	21/22/23
22.	Control relays, transformers	21/22/23	21/22/23	21/22/23
23.	Refrigeration cycle, cooling tower and controls	23	23	23
24.	Tamper switches for fire protection (sprinkler) system	21	21	28
25.	Flow and/or pressure switches for fire protection (sprinkler) system	21	21	28
26.	Fire and jockey pump controllers and automatic transfer switch	21	21	Note 6
27.	Alarm bells or horns for fire protection (sprinkler) system	21	21	28
28.	Generator (underground) fuel tank	22	22	--
29.	Generator fuel level indicator	22	22	26

30.	Generator fuel piping from tank to generator	22	22	--				
31.	Underground fuel tank leak detection and monitoring system	22	22	22	ITEM	FURNISHED UNDER DIVISION	INSTALLED UNDER DIVISION	WIRED AND CONNECTED UNDER DIVISION

Notes:

(1) Power wiring as defined in Section 26 29 13 of the specifications shall be provided under Division 26; control wiring as defined in Section 26 29 13 of the specifications shall be provided under Division 21/22/23.

(2) Wiring from alarm contacts to alarm systems provided by Division 26, wiring from auxiliary contacts to air handling system controls provided by Division 23. Division 26 shall provide power to smoke detector. Smoke detectors required for all air handling systems 2000 CFM or greater. Refer to other Division 23 specifications, Division 26 and Drawings for more specific requirements.

(3) For requirements for Magnetic Motor Starters, refer to Section 23 89 65 - MOTOR CONTROLLERS.

(4) For requirements for Variable Speed (Frequency) AC drives, refer to Section 23 89 65 - MOTOR CONTROLLERS.

(5) Disconnect switches, operating switches, starters and other similar items that are factory-mounted, as a part of complete assembly, shall comply with applicable provisions of the National Electric Code. All such disconnect switches shall be fused.

(6) Power wiring from energy source to controllers and automatic transfer switch shall be provided under Division 26. Interconnection power and control wiring from controllers and automatic transfer switch to pumps shall be provided under Division 21, 22 or 23 and conforming to Division 26 specifications. Control wiring from automatic transfer switch to generator starter shall be provided under Division 26.

(7) Division 26 will provide power to all smoke and combination fire/smoke dampers, and Division 28 will provide control for all such dampers using area smoke detectors.

(8) Wiring for sprinkler system controls to be provided by Division 21. Wiring from devices to Fire Alarm System to be provided by Division 28.

B. Connections: Make all connections to controls that are directly attached to ducts, piping and mechanical equipment with flexible connections.

C. Precedence

1. In general, piping systems that require a stated grade for proper operation shall have precedence over other systems.
2. Precedence for pipe, conduit and duct systems shall be as follows.
    a. Building lines
    b. Structural members
    c. Soil and drain piping
    d. Vent piping
    e. Steam piping
    f. Condensate piping
    g. Refrigerant piping
    h. Electrical bus duct
    i. Supply ductwork
    j. Return ductwork
    k. Exhaust ductwork
    l. Chilled water and heating water piping
    m. Automatic Fire Protection Sprinkler Piping
    n. Natural gas piping
    o. Domestic hot and cold water piping
    p. Electrical conduit
3. Lighting Fixtures shall have precedence over air grilles and diffusers.

D. Final Inspection and Report

1. At the completion of the work, there shall be a meeting of the Fire Protection, Plumbing, Mechanical, Electrical Fire Alarm and Temperature Control Contractors, representatives of mechanical and electrical equipment manufactures whose equipment was actually installed on the project, and similarly-involved individuals, who shall thoroughly inspect all systems, and who shall mutually agree that all equipment has been properly wired and installed, and that all temperature and safety controls are properly functioning. A written report of this meeting, listing those in attendance, and the companies that they represent, shall be filed with the Owner and Architect or Engineer.

END OF SECTION

SECTION 23 05 29

MECHANICAL SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of supports and anchors required by this section is indicated on Drawings and/or specified in other Division 23 sections.

B. Types of supports and anchors specified in this section include the following:

1. Pipe and equipment hangers, supports, and anchors.
2. Equipment bases.

C. Supports and anchors furnished as part of factory-fabricated equipment are specified as part of equipment assembly in other Division 23 sections.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of supports and anchors, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. Code Compliance: Comply with applicable plumbing codes pertaining to product materials and installation of supports and anchors.
2. Fire Protection Compliance: Install in accordance with NFPA 13-latest edition. Provide products that are UL-listed and FM approved.
3. MSS Standard Compliance:
    a. Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-58.
    b. Select and apply pipe hangers and supports, complying with MSS SP-69.
    c. Fabricate and install pipe hangers and supports, complying with MSS SP-89.
    d. Terminology used in this section is defined in MSS SP-90.

C. All hangers, supports and attachments shall be manufactured with materials compatible with the environment in which they will be installed. Unless directed otherwise, all hangers, supports, and attachments installed exterior to the building or within high humidity environments shall be galvanized steel or stainless steel.

D. Manufacturers of Hangers and Supports:

1. Manufacturer: Subject to compliance with requirements, provide hangers and supports of one of the following:
    a. B-Line Systems Inc. (Cooper)
    b. ANVIL International

1.3 SUBMITTALS

A. Submit product data as required under provisions of Division 01 and Section 23 00 10.

B. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor. Submit pipe hanger and support schedule showing Manufacturer's figure number, size, location, and features for each required pipe hanger and support.

C. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly of components.

D. Maintenance Data: Submit maintenance data and parts list for each type of support and anchor. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 01.

PART 2 - PRODUCTS

2.1 HORIZONTAL-PIPING HANGERS AND SUPPORTS

A. General: Except as otherwise indicated, provide factory-fabricated horizontal-piping hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems.

B. Adjustable Steel Clevis Hangers: MSS Type 1.

C. Yoke Type Pipe Clamps: MSS Type 2.

D. Steel Double Bolt Pipe Clamps: MSS Type 3.

E. Steel Pipe Clamps: MSS Type 4.

F. Pipe Hangers: MSS Type 5.

G. Split Pipe Rings: MSS Type 11.

H. Pipe Saddle Supports: MSS Type 36, including steel pipe base-support and cast-iron floor flange.

I. Adjustable Pipe Saddle Supports: MSS Type 38, including steel pipe base support and cast-iron floor flange.

J. Single Pipe Rolls: MSS Type 41.

K. Adjustable Roller Hangers: MSS Type 43.

2.2 VERTICAL-PIPING CLAMPS

A. General: Except as otherwise indicated, provide factory-fabricated vertical-piping clamps complying with MSS SP-58, of one of the following types listed, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper-plated clamps for copper-piping systems.

B. Two-Bolt Riser Clamps: MSS Type 8.

C. Four-Bolt Riser Clamps: MSS Type 42.

2.3 HANGER-ROD ATTACHMENTS

A. General: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems.

B. Steel Turnbuckles: MSS Type 13.

C. Steel Clevises: MSS Type 14.

D. Swivel Turnbuckles: MSS Type 15.

E. Malleable Iron Sockets: MSS Type 16.

F. Steel Weldless Eye Nuts: MSS Type 17.

2.4 BUILDING ATTACHMENTS

A. General: Except as otherwise indicated, provide factory-fabricated building attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Provide copper-plated building attachments for copper-piping systems.

B. Top Beam C-Clamps: MSS Type 19.

C. Side Beam or Channel Clamps: MSS Type 20.

D. Center Beam Clamps: MSS Type 21.

E. Welded Beam Attachments: MSS Type 22.

F. C-Clamps: MSS Type 23.

G. Top Beam Clamps: MSS Type 25.

H. Side Beam Clamps: MSS Type 27.

I. Steel Beam Clamps W/Eye Nut: MSS Type 28.

J. Linked Steel Clamps W/Eye Nut: MSS Type 29.

K. Malleable Beam Clamps: MSS Type 30.

L. Steel Brackets: One of the following for indicated loading:

1. Light Duty: MSS Type 31, suspending 750 lbs. max.
2. Medium Duty: MSS Type 32, suspending 1500 lbs. max.
3. Heavy Duty: MSS Type 33, suspending 3000 lbs. max.

M. Side Beam Brackets: MSS Type 34.

N. Plate Lugs: MSS Type 57.

O. Horizontal Travelers: MSS Type 58.

2.5 CONCRETE INSERTS

A. Drill-In Spot Type: Steel, attached wedge, lock washer and nut. Size inserts to suit threaded hanger rod.

1. Acceptable Manufacturers and Models:

a. Hilti "Kwik Bolt"

b. Ramset "Wedge Anchor"

c. Rawl "Stud"

B. Continuous Channel Type: Steel, anchoring lugs, with channel nuts, rated for 2000 lbs. per foot minimum load. Size channel nut to suit threaded hanger rod.

1. Acceptable Manufacturers and Models:

a. B-Line B22

b. Elcen 1150

c. Unistrut P3200

2.6 SADDLES AND SHIELDS

A. General: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.

B. Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.

C. Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation.

D. Thermal Hanger Shields: Constructed of 360° insert of high density, 125-psi compressive strength, and water-proofed calcium silicate, encased in 360° sheet metal shield. Provide assembly of same thickness as adjoining insulation.

1. Manufacturer: Subject to compliance with requirements, provide thermal hanger shields of one of the following:

a. Elcen Metal Products Co.

b. Pipe Shields, Inc.

2.7 SPRING HANGERS AND SUPPORTS

A. General: Except as otherwise indicated, provide factory-fabricated spring hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select spring hangers and supports to suit pipe size and loading.

B. Restraint Control Devices: MSS Type 47.

C. Variable Spring Hangers: MSS Type 51; preset to indicated load and limit variability factor to 25%.

2.8 MISCELLANEOUS MATERIALS

A. Metal Framing: Provide products complying with NEMA STD ML 1.

B. Steel Plates, Shapes and Bars: Provide products complying with ASTM A 36.

C. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

D. Auxiliary Steel: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS standards.

E. Pipe Guides: Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of bolted two-section outer cylinder and base with two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

2.9 ROOF EQUIPMENT SUPPORTS

A. General: Construct roof equipment supports using minimum 18 ga. galvanized steel with fully mitered and welded corners, 3 in. cant, internal bulkhead reinforcing, integral base plates, pressure treated wood nailer, and 18 ga. galvanized steel counter flashing.

B. Configuration: Construct of sizes as indicated, compensate for slope in roof so top of support is dead level.

C. Manufacturer: Subject to compliance with requirements, provide roof equipment supports of one of the following:

1. Pate Co.
2. Thycurb Div.; Thybar Corp.

2.10 ROOF PIPING SUPPORTS

A. Single run pipe 2-1/2 in. O.D. and less, shall have Type SS8-C or SS8-R as manufactured by PHP Systems/Design, or an approved equal, spaced at a maximum 8 ft. o.c. and installed on roof pads if required by Roofing Manufacturer. Use roller support for all straight piping lengths of 50 ft. or greater. All piping on fixed support shall be strapped to support channel. Coordinate exact locations of supports with Roofing Contractor. Do not use wood blocking under supports.

B. All condensate piping on the roof shall be supported with Dura-Blok supports by Cooper B-Line, DBM series or approved equal. Spacing of pipe supports shall not exceed 6 ft. Install piping supports per manufacturer's instructions. Pipe supports shall be constructed of 9.5 in.-L x 6 in.-W x 4 in.-H recycled rubber, UV resistant, with a 14 gauge channel strut secured to rubber base. All piping shall be clamped and secured to the adjustable 3/8 in. Electro Zinc all threaded red. Provide copper, hinged pipe clamp.

C. All refrigerant piping on the roof shall be supported with Pipe Pier model PP050 piping supports or approved equal. Spacing of pipe supports shall not exceed 8 ft. for pipes up to 1-1/4 in. and 10 ft. on all other piping. Coordinate exact locations of supports with Roofing Contractor. Install piping supports per manufacturer's instructions. Pipe supports shall be constructed of 10 in.-L x 4 in.-W x 4 in.-H closed cell, medium density black polyethylene foam with a 14 ga. channel strut adhesively bonded to the polyethylene foam. Roofing Contractor shall provide roofing material pads under all supports.

2.11 ROOF PENETRATION SYSTEMS

A. General: Construct roof penetration systems utilizing the "Alumi-Flash" system by Portals Plus, Inc., or equal by Thy-Curb.

B. Each roof penetration shall include a spun aluminum base ("High" size if required due to the existing roof construction and any insulation thickness) and an EPDM rubber cap. Each rubber cap shall have a pre-molded pipe opening and shall be selected based on the actual pipe or conduit size required at each location. Secure each rubber cap to each pipe or conduit with the manufacturer's recommended stainless steel gear clamp.

C. Manufacturer: Subject to compliance with requirements, provide roof penetration systems of one of the following:

1. Portals Plus, Inc.
2. Thycurb Div.; Thybar Corp.

2.12 ON GRADE PIPING SUPPORTS

A. All refrigerant piping on the ground shall be supported with Dura-Blok supports by Cooper B-Line, DB series or approved equal. Install piping supports per manufacturer's instructions. Pipe supports shall be constructed of 9.5 in. L x 6 in. W x 4 in. H recycled rubber, UV resistant, with a 14 gauge channel strut secured to rubber base. All piping shall be clamped and secured to the channel strut. Spacing of pipe supports shall not exceed 6 ft.

2.13 CONCRETE HOUSEKEEPING BASES

A. Concrete housekeeping bases shall be in accordance with Division 3 and constructed of 4,000 psi concrete and reinforced with welded wire fabric in accordance with ASTM A 185 or deformed reinforcing bar in accordance with ASTM A 615, Grade 60.

B. Reinforcement shall be provided for base thickness as follows unless otherwise noted.

Thickness of Base	Size and Type of Reinforcement	Spacing and Location of Reinforcement
4 in.	W 2.9 x 2.9 welded	6 in. x 6 in. at centerline of pad
6 in.	No. 3 bars	18 in. on center each way (3 in. from top of pad
8 in.	No. 4 bars	18 in. on center each way (3 in. from top of pad)
12 in.	2 sets of No. 4 bars	Two mats 18 in. on center each way (3 in. from top of pad and 3 in. from bottom of pad)

2.14 SLEEVES, INSETS AND FASTENINGS

A. Pipes passing through concrete or cinder walls and floor or other corrosive material shall be protected by a protective sheathing or wrapping or by sleeves, as required to meet the local code. Annular spaces between sleeves and pipes shall be filled or tightly caulked in an approved manner. Annular spaces between sleeves and pipes in fire-resistance-rated assemblies shall be filled or tightly caulked in accordance with the local code.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which supports and anchors are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 PREPARATION

A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments.

B. Prior to installation of hangers, supports, anchors and associated work, Installer shall meet at project site with Contractor, installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section and for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

3.3 INSTALLATION OF BUILDING ATTACHMENTS

A. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at all changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through openings at top of inserts.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Install additional at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at all changes in direction of piping. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

C. Support fire-water piping independently of other piping.

D. Prevent electrolysis in support of copper tubing by use of hangers and supports that are copper plated, or by other recognized industry methods.

E. Support and laterally brace vertical pipe runs at every floor level and at intervals not to exceed 20 ft. 0 in. Support vertical pipe with riser clamps installed below hubs, couplings or lugs welded to the pipe.

F. Provisions for Movement:

1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.

2. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

3. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 Pressure Piping Codes are not exceeded.

G. Insulated Piping: Comply with the following installation requirements.

1. Clamps: Attach clamps, including spacers (if any), to piping with clamps; do not exceed pipe stresses allowed by ANSI B31.

2. Piping hangers shall be sized large enough to allow insulation to pass through. Hangers for piping 2-1/2 in. and greater shall be provided with pipe covering protection saddle, or high compressive strength insulation saddle. Hangers for piping 2 in. and less shall be provided with pipe covering shields. On cold or chilled water piping provide vapor barrier through hanger.

3. Do NOT utilize "pipe size" hangers or clamps with insulation placed over the pipe and hanger or clamp.

H. Unless directed otherwise, all hangers, supports, and attachments installed exterior to the building or within high humidity environments shall be galvanized steel or stainless steel.

3.5 INSTALLATION OF ANCHORS

A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31, and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure. Comply with ANSI B31 and with AWS standards.

C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions, to limit movement of piping and forces to maximums recommended by manufacturer for each unit.

D. Anchor spacings: Where not otherwise indicated, install anchors at ends of principal pipe-runs, at intermediate points in pipe-runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

3.6 CONCRETE HOUSEKEEPING BASES

A. Provide concrete housekeeping bases for all floor-mounted equipment furnished as part of the work of Division 23 in accordance with Division 03. Size bases to extend minimum of 4 in. beyond equipment base in any direction; and 4 in. above finished floor elevation, unless otherwise noted on Drawing. Construct of reinforced concrete, roughen floor slab beneath base for bond, and provide steel rod anchors between floor and base. Locate anchor bolts using equipment manufacturer's templates. Chamfer top and edge corners.

3.7 EQUIPMENT SUPPORTS

A. Provide structural steel stands to support equipment not floor mounted or hung from structure. Construct of structural steel members or steel pipe and fittings. Provide factory-fabricated tank saddles for tanks mounted on steel stands.

B. Furnish roof equipment supports to Contractor for installation as part of work of Division 07; not work of this section.

3.8 ADJUSTING AND CLEANING

A. Hanger Adjustments: Adjust hangers so as to distribute loads equally on attachments.

B. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.

C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

SECTION 23 05 53

MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of mechanical identification work required by this section is indicated on Drawings and/or specified in other Division 23 sections.

B. Types of identification devices specified in this section include the following:

1. Plastic Pipe Markers.
2. Plastic Tape.
3. Underground-Type Plastic Line Marker.
4. Plastic Duct Markers.
5. Valve Tags.
6. Valve Schedule Frames.
7. Engraved Plastic-Laminate Signs.
8. Plastic Equipment Markers.
9. Plasticized Tags.

C. Mechanical identification furnished as part of factory-fabricated equipment, is specified as part of equipment assembly in other Division 23 sections.

D. Refer to other Division 23 sections for identification requirements at central-station mechanical control center; not work of this section.

E. Refer to Division 26 sections for identification requirements of electrical work; not work of this section.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.

B. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2 in. x 11 in. bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule. In addition to mounted copies, furnish extra copies for Maintenance Manuals as specified in Division 01.

C. Maintenance Data: Include product data and schedules in maintenance manuals; in accordance with requirements of Division 01.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide mechanical identification materials of one of the following:

1. Allen Systems, Inc.
2. Brady (WHO) Co.; Signmark Div.
3. Industrial Safety Supply Co., Inc.
4. Seton Name Plate Corp.

2.2 MECHANICAL IDENTIFICATION MATERIALS

A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 23 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.3 PLASTIC PIPE MARKERS

A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1.

B. Pressure-Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color-coded, and pressure-sensitive vinyl pipe markers, complying with ANSI A13.1.

C. Small Pipes: For external diameters less than 6 in. (including insulation if any), provide full-band pipe markers, extending 360° around pipe at each location, fastened by one of the following methods:

1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
2. Adhesive lap joint in pipe marker overlap.
3. Laminated or bonded application of pipe marker to pipe (or insulation).
4. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4 in. wide; full circle at both ends of pipe marker, tape lapped 1-1/2 in.

D. Lettering: Manufacturer's standard pre-printed nomenclature that best describes piping system in each instance, as selected by Architect in cases of variance with name as shown or specified.

E. Lettering: Comply with piping system nomenclature as specified, scheduled or shown, and abbreviate only as necessary for each application length.

1. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

2.4 PLASTIC DUCT MARKERS

A. General: Provide manufacturer's standard laminated plastic, color-coded duct markers. Conform to the following color code:

1. Green: Cold air.
2. Yellow: Hot air.
3. Yellow/Green: Supply air.
4. Blue: Exhaust, outside, return, and mixed air.
5. For hazardous exhausts, use colors and designs recommended by ANSI A13.1.

B. Nomenclature: Include the following:

1. Direction of airflow.
2. Duct service (supply, return, exhaust, etc.).
3. Duct origin (from).
4. Duct destination (to).
5. Design CFM.

2.5 PLASTIC TAPE

A. General: Provide manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.

B. Width: Provide 1-1/2 in. wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6 in., 2-1/2 in. wide tape for larger pipes.

C. Color: Comply with ANSI A13.1, except where another color selection is indicated.

2.6 VALVE TAGS

A. Brass Valve Tags: Provide 19-gauge polished brass valve tags with stamp-engraved piping system abbreviation in 1/4 in. high letters and sequenced valve numbers 1/2 in. high, and with 5/32 in. hole for fastener.

1. Provide 1+ in. diameter tags, except as otherwise indicated.
2. Provide size and shape as specified or scheduled for each piping system.
3. Fill tag engraving with black enamel.

B. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

C. Access Panel Markers: Provide manufacturer's standard 1/16 in. thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8 in. center hole to allow attachment.

2.7 VALVE SCHEDULE FRAMES

A. General: For each page of valve schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

2.8 ENGRAVED PLASTIC-LAMINATE SIGNS

A. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

B. Thickness: 1/16 in. for units up to 20 sq. in. or 8 in. length; 1/8 in. for larger units.

C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.9 PLASTIC EQUIPMENT MARKERS

A. General: Provide manufacturer's standard laminated plastic, color-coded equipment markers. Conform to the following color code:

1. Green: Cooling equipment and components.
2. Yellow: Heating equipment and components.
3. Yellow/Green: Combination cooling and heating equipment and components.
4. Brown: Energy reclamation equipment and components.
5. Blue: Equipment and components that do not meet any of the above criteria.
6. Red: Fire protection equipment and components.
7. For hazardous equipment, use colors and designs recommended by ANSI A13.1.

B. Nomenclature: Include the following, matching terminology on schedules as closely as possible:

1. Name and plan number.
2. Equipment service.
3. Design capacity.
4. Other design parameters such as pressure drop, entering and leaving conditions, rpm, etc.

C. Size: Provide approximate 2-1/2 in. x 4 in. markers for control devices, dampers, and valves; and 4-1/2 in. x 6 in. for equipment.

2.10 PLASTICIZED TAGS

A. General: Manufacturer's standard pre-printed or partially pre-printed accident-prevention tags, have plasticized card stock with matt finish suitable for writing, approximately 3-1/4 in. x 5-5/8 in., with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

2.11 LETTERING AND GRAPHICS

A. General: Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.

1. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification that indicates individual system number as well as service (as examples; Boiler No. 3, Air Supply No. 1H, Standpipe F12).

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Coordination: Where identification is to be applied to surfaces that require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 DUCTWORK IDENTIFICATION

A. General: Identify air supply, return, exhaust, intake and relief ductwork with duct markers; or provide stenciled signs and arrows, showing ductwork service and direction of flow, in black or white (whichever provides most contrast with ductwork color).

B. Location: In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground or similar concealment), and at 20' spacings along exposed runs.

C. Access Doors: Provide duct markers or stenciled signs on each access door in ductwork and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions, and appropriate safety and procedural information.

D. Concealed Doors: Where access doors are concealed above acoustical ceilings or similar concealment, plasticize tags may be installed for identification in lieu of specified signs, at Installer's option.

3.3 PIPING SYSTEM IDENTIFICATION

A. General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:

1. Plastic pipe markers, with application system as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot non-insulated pipes.

B. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.

1. Near each valve and control device.

2. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.

3. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures on both sides of penetration.
4. At access doors, manholes and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced intermediately at maximum spacing of 20 ft. along each piping run, except reduce spacing in congested areas of piping and equipment, where required for clarity.
7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

C. Piping Identification

1. Provide piping identification for the following:

System	Background Color	Text Color
Chilled Water Supply	Green	White
Chilled Water Return	Green	White

3.4 VALVE IDENTIFICATION

A. General: Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibs, and shut-off valves at plumbing fixtures, HVAC terminal devices and similar rough-in connections of end-use fixtures and units. List each tagged valve in valve schedule for each piping system.

1. Tagging Schedule: Comply with requirements of "Valve Tagging Schedule" at end of this section.

B. Mount valve schedule frames and schedules in machine rooms where indicated or, if not otherwise indicated, where directed by Architect.

3.5 MECHANICAL EQUIPMENT IDENTIFICATION

A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:

1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
2. Meters, gauges, thermometers and similar units.
3. Pumps, compressors, chillers, condensers and similar motor-driven units.
4. Heat exchanger, coils, evaporators, cooling towers, heat recovery units and similar equipment.
5. Fans, blowers, primary balancing dampers and mixing boxes.
6. Packaged HVAC central-station and zone-type units.
7. Tanks and pressure vessels.
8. Strainers, filters, humidifiers, water treatment systems and similar equipment.

B. Lettering Size: Minimum 1/4 in. high lettering for name of unit where viewing distance is less than 2 ft. 0 in., 1/2 in. high for distances up to 6 ft. 0 in., and proportionately larger lettering for greater distances. Provide secondary lettering 2/3 to 3/4 of size of principal lettering.

C. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

D. Optional Use of Plasticize Tags: At Installer's option, where equipment to be identified is concealed above acoustical ceiling or similar concealment, plasticize tags may be installed within concealed space to reduce amount of text in exposed sign (outside concealment).

1. Operational valves and similar minor equipment items located in non-occupied spaces (including machine rooms) may, at Installer's option, be identified by installation of plasticize tags in lieu of engraved plastic signs.

3.6 ADJUSTING AND CLEANING

A. Adjusting: Relocate any mechanical identification device, which has become visually blocked by work of this division or other divisions.

B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

3.7 EXTRA STOCK

A. Furnish minimum of 5% extra stock of each mechanical identification material required, including additional numbered valve tags (not less than 3) for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.

END OF SECTION

SECTION 23 05 93

MECHANICAL TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 SUMMARY

A. Adjust and balance Mechanical Water systems

B. Adjust and balance Mechanical Air systems

C. Check each piece of operating equipment provided under Division 23.

D. Provide Balancing Report

1.2 QUALITY ASSURANCE

A. Independent Subcontractor: All testing, adjusting and balancing shall be performed by a Testing, Adjusting and Balancing firm that is independent from the HVAC systems installer.

B. Balancing Work: Under direct supervision of AABC accredited testing organization certified supervisor.

1.3 REFERENCES

A. Reference Standards: Comply with AABC National Standards for Total System Balance, latest edition.

1.4 SUBMITTALS

A. Certificate: Before beginning work, submit certification of AABC certified supervisor and AABC firm certification in accordance with Section 23 00 10.

B. Balancing Report: At completion of work, submit balancing report in accordance with Section 23 00 10. After adjustments have been made submit three (3) copies of a complete detailed report on mechanical systems and their operation to include:

1. Blackline prints with air openings marked to correspond with data sheets and with thermometer locations clearly marked.
2. Data sheets showing amount of air handled at each opening, instrument used, velocity readings and manufacturer free area factors.
3. Equipment data sheets giving make, size, etc., of fans, motors and drives. Include supply fans, exhaust and recirculating fans.
4. Operating data including fan RPM, measured motor current and voltage BHP and CFM (total).
5. Equipment and operating data at each section of the unit and at the unit connection points including air temperatures entering and leaving coils (maximum air temperature rise), together with corresponding air flow and air pressure drop, water temperatures entering and leaving coils.
6. Equipment and operating data as required to show performance of H&V units, fan coils, cabinet heaters, unit heaters, temperature control devices, pumps and domestic hot water circulating systems.
7. Static pressure loss across variable air volume boxes and associated reheat coils.

8. Prime source refrigeration equipment operating data at design conditions including temperature measurements, flow conditions and corresponding power consumption.
9. A statement outlining any abnormal or notable conditions not covered in above data. Make special note of any discrepancies between tabulated data and specified conditions.

1.5 PROJECT CONDITIONS

A. Existing Conditions: Verify following conditions before proceeding with work:
   1. Installation of the designated system is complete and in full operation.
   2. Outside temperature conditions, occupant loads, lighting loads, special equipment requiring extra sensible or ventilation requirements, and solar conditions are within a reasonable range relative to design conditions.

PART 2 - PRODUCTS

2.1 INSTRUMENTS

A. Calibration and maintenance of instruments shall be in accordance with manufacturer's standards and recommendations and requirements of AABC.

B. Calibration histories for each instrument shall be available for examination.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect preceding work in accordance with Section 23 00 10 BASIC MECHANICAL REQUIREMENTS.

3.2 PREPARATION

A. Water Systems: Check:
   1. Strainers are clean.
   2. Other conditions as required.

B. Air Systems: Check:
   1. Filters are clean.
   2. Filter leakage.
   3. Damper operation and leakage.
   4. Duct leakage.
   5. Fan rotation.
   6. Equipment vibration.

3.3 ADJUSTING AND BALANCING

A. General: Check, adjust and balance air and water system to meet the design performance and tabulate results on acceptable forms. Minimum data to include amperage, voltage input, and thermal heater capacity of each motor, equipment nameplate data and operating speed, pressure drop across each filter bank, pressure rise across each fan and pump, CFM capacity each outlet, zone and fan, and heating or cooling capacity of each coil or element.

B. Belt Drives: Adjust so that when the desired speed and belt tension had been established, the variable speed pulley and the belt tension adjustment shall be at approximately the midpoint of their range.

C. Air Systems:

1. Adjust dampers for the delivery and distribution of air quantities indicated on the drawings.
2. Mark balancing device at final setting.
3. Replacement of adjustable pulleys, installation of additional balancing dampers or pressure taps, required to effect proper air balance shall be furnished and installed by the HVAC Contractor at no additional cost to the Owner.
4. Adjust exhaust and recirculation air systems for air quantities indicated on drawings and to establish the proper relationship between supply and exhaust.
5. Adjust distribution system to obtain uniform space temperature free from objectionable drafts and noise within the capabilities of the system.
6. Acceptable Tolerances: Adjust fan systems, air devices, etc. as follows:
    a. Supply air fan CFM: -5% to +5% of scheduled
    b. Return air fan CFM: -5% to +5% of scheduled
    c. Exhaust air fan CFM: -0% to +10% of scheduled
    d. Supply air device CFM: -10% to +10% of scheduled
    e. Return air device CFM: -10% to +10% of scheduled
    f. Exhaust air device CFM: -0% to +10% of scheduled
    g. Outside air CFM: -0% to +10% of scheduled

D. Test Run: In order to determine that the system installation is complete and will operate satisfactorily, make a test run with equipment operating per normal temperature control schedule and sequence. Run test and operate and adjust equipment as may be required during test run.

3.4 COMPLETION SERVICES

A. Final Check: Make final checks and do any rebalancing as directed.

B. Report: Submit Balancing Report as specified above.

C. Acceptance: Final acceptance of the project will not be made until a satisfactory report is received. Owner reserves the right to spot check the report by field verification prior to final acceptance.

END OF SECTION

SECTION 23 07 13

HVAC DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of mechanical insulation required by this section is indicated on Drawings and schedules, and by requirements of this section.

B. Types of mechanical insulation specified in this section include the following:

1. Ductwork System Insulation:

a. Fiberglass

C. Refer to Section 23 05 29 - MECHANICAL SUPPORTS AND ANCHORS for protection saddles, protection shields, and thermal hanger shields; not work of this section.

D. Refer to Section 23 31 13 - METAL DUCTWORK for duct linings; not work of this section.

1.2 REFERENCES

A. NFPA 90A Standard for the Installation of Air-Conditioning and Ventilating Systems.

B. NFPA 90B Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

C. UL 723 Standard for Test for Surface Burning Characteristics of Building Materials.

D. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.

E. ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials.

F. ASTM E119 Standard Test Method for Fire Tests of Building Construction and Materials.

G. ASTM E136 Standard Test Method for Behavior of materials in a Vertical Tube Furnace at 750ºC.

H. ASTM C177 Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

I. ASTM C411 Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

J. ASTM C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

K. ASTM C553 Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

L. ASTM C612 Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

M. ASTM C 916 Standard Specification for Adhesives for Duct Thermal Insulation.

N. ASTM C1071 Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).

O. ASTM C1290 Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC.

P. ASTM C1393 Standard Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes and Tanks.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Installer's Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.

C. Flame/Smoke Ratings: Provide composite mechanical (insulating material, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (UL723) method.

D. Insulations shall not contain formaldehyde, asbestos, lead, mercury, mercury compounds, or poly-brominated diphenyl ether fire retardants.

E. Fiberglass insulations shall have a minimum of 50 percent recycled glass content; certified and UL Validated.

F. Fiberglass insulations shall have a bio-based, formaldehyde-free binder and be UL GREENGUARD Gold certified.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide fiberglass products of one of the following:

1. Certainteed.
2. Manson.
3. Knauf.
4. Johns Manville.
5. Owens-Corning.

B. Manufacturer: Subject to compliance with requirements, provide grease duct insulation products of one of the following:

1. Morgan Thermal Ceramics.
2. UNIFRAX.

3. 3M.
4. Johns Manville.

2.2 DUCTWORK INSULATION MATERIALS

A. Rigid Fiberglass Ductwork Insulation: ASTM C 612, Type IA.

B. Flexible Fiberglass Ductwork Insulation: ASTM C 553, Type I

C. Jackets for Ductwork Insulation: ASTM C 921, Type I (vapor barrier) for ductwork with temperatures below ambient; Type II for ductwork with temperatures above ambient.

D. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.

E. Ductwork Insulation Compounds: Provide cements, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.

2.3 METAL PROTECTIVE JACKET

A. Sheet aluminum: ASTM C1729, 3003 alloy, H-14 temper, and 0.016-in. thick. Provide moisture barrier lining for service temperatures 60°F or less except where applied over a Type I or II jacket. Longitudinal lap shall be at least two inches wide.

B. Stainless Steel: ASTM C1767, manufactured from T-304 prime grade Stainless Steels, supplied with a regular dull finish for reduced glare and 0.016-in. thick. These alloys shall be of a soft-annealed temper, for ease in fabrication. Jacketing shall be used for insulated piping, tanks, and vessels less than 8 ft. in diameter. Deep corrugated sheets shall be used for diameters greater than 8 ft. Roll jacketing shall be 3/16 in. corrugated.

C. Fitting covers: Factory fabricated from not lighter than 0.020 in. thick type 3003 sheet aluminum.

D. Bands: 3/4-in. wide aluminum on maximum 18-in. centers.

E. Provide metal jackets over insulation as follows:

1. All insulation exposed to outdoor weather.
2. Insulation exposed in building within five (5) ft. of the floor that connect to sterilizers, kitchen and laundry equipment. Do not penetrate jackets with screws or pop rivets. Provide aluminum angle ring escutcheons at wall, ceiling and floor penetrations.
3. A two-inch overlap is required at longitudinal and circumferential joints.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

B. Thickness of insulation shall be as recommended by the manufacturer for the temperatures and duct sizes involved, and in accordance with standards of NAIMA.

3.2 DUCTWORK SYSTEM INSULATION

A. Insulation Omitted: Do not insulate fibrous glass ductwork or lined ductwork.

B. Dual Temperature Ductwork:

1. Application Requirements: Insulate the following dual temperature ductwork:

a. Hot/cold supply and return ductwork between fan discharge or HVAC unit discharge and room terminal outlets; except omit insulation on return air ductwork located in return air ceiling plenums.

2. Insulate each ductwork system specified above with one of the following types and thicknesses of insulation:

a. Rigid Fiberglass: 1-1/2 in. thick, increase thickness to 2 in. in machine, fan and equipment rooms.

b. Flexible Fiberglass: 2.2 in. thick, application limited to concealed locations. Flexible insulation will not be used in machine, fan and equipment rooms.

C. Cold Ductwork (Below Ambient Temperature):

1. Application Requirements: Insulate the following cold ductwork:

a. Outdoor air intake ductwork between air entrance and fan inlet or HVAC unit inlet.

b. HVAC supply ductwork between fan discharge, or HVAC unit discharge and room terminal outlet.

c. Insulate neck and bells of supply diffusers.

d. HVAC return ductwork between room terminal inlet and return fan inlet, or HVAC unit inlet; except omit insulation on return ductwork located in return air-ceiling plenums.

e. HVAC plenums and unit housings not pre-insulated at factory or lined.

2. Insulate each ductwork system specified above with one of the following types and thicknesses of insulation:

a. Rigid Fiberglass: 2.2 in. thick, increase thickness to 3 in. in machine, fan and equipment rooms.

b. Flexible Fiberglass: 2 in. thick, application limited to concealed locations. Flexible insulation will not be used in machine, fan and equipment rooms.

D. Ductwork insulation density and thickness shall comply with applicable IECC requirements: Minimum installed R-value of 6.0 inside the building envelope, R-value of 8.0 outside the building envelope.

3.3 INSTALLATION OF DUCTWORK INSULATION

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

B. Install insulation materials with smooth and even surfaces.

C. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

D. Maintain integrity of vapor-barrier on ductwork insulation, and protect it to prevent puncture and other damage.

E. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where otherwise indicated.

F. Lined Ductwork: Except as otherwise indicated, omit insulation on ductwork where internal insulation or sound absorbing linings have been installed to meet IECC requirements.

G. Corner Angles: Except for oven and hood exhaust duct insulation; install corner angles on external corners of insulation on ductwork in exposed finished spaces before covering with jacketing.

3.4 INSULATION EXPOSED TO WEATHER

A. Protect outdoor insulation from weather by installation of weather-barrier metal jacketing. It may be factory-applied or field applied. Joints shall be overlapped a minimum of 2 in. Securement shall be accomplished by using stainless steel bands. Any vapor-barrier jacket or coating under the metal jacketing shall not be disturbed or punctured by the use of screws or rivets on the outer jacket. Cross-break the jacketing on top of all rectangular ducts to ensure positive drainage.

3.5 EXISTING INSULATION REPAIR

A. Repair damaged sections of existing mechanical insulation, both previously damaged or damaged during this construction period. Use insulation of same thickness as existing insulation, install new jacket lapping and sealed over existing.

3.6 PROTECTION AND REPLACEMENT

A. Replace damaged insulation that cannot be repaired satisfactorily, including units with vapor barrier damage and moisture-saturated units.

B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION

SECTION 23 07 19

HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of mechanical insulation required by this section is indicated on Drawings and schedules, and by requirements of this section.

B. Types of mechanical insulation specified in this section include the following:

1. Piping System Insulation:

a. Fiberglass.

b. Elastomeric Foam.

C. Refer to Section 23 05 29 "MECHANICAL SUPPORTS AND ANCHORS" for protection saddles, protection shields, and thermal hanger shields; not work of this section.

D. Refer to Section 23 31 13 "METAL DUCTWORK" for duct linings; not work of this section.

E. Refer to Section 23 05 53 "MECHANICAL IDENTIFICATION" for installation of identification devices for piping, ductwork, and equipment; not work of this section.

1.2 REFERENCES

A. North American Commercial and Industrial Insulation Standards. 9th Edition or Latest Edition. Published by Midwest Insulation Contractors Association (MICA).

B. NAIMA CI228 Guide to Insulating Chilled Water Piping Systems with Mineral Fiber Pipe Insulation 33°F to 60°F (0.5°C to 15.6°C) First Edition, 2015. Published by North American Insulation Manufacturers Association (NAIMA).

C. UL 723 Standard for Test for Surface Burning Characteristics of Building Materials.

D. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials.

E. ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials.

F. ASTM C335 Standard Test Method for Steady-State Heat Transfer Properties of Pipe Insulation.

G. ASTM C534 Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

H. ASTM C547 Standard Specifications for Mineral Fiber Pipe Insulation.

I. ASTM C585 Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).

J. ASTM C795 Standard Specifications for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

K. ASTM C1136 Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.

L. ASTM C1393 Standard Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Installer's Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.

C. Flame/Smoke Ratings: Provide composite mechanical (insulating material, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (UL 723) method.

D. Insulations shall not contain formaldehyde, asbestos, lead, mercury, mercury compounds, or poly-brominated diphenyl ether fire retardants.

E. Fiberglass insulations shall have a minimum of 50 percent recycled glass content; certified and UL Validated.

F. Fiberglass insulations shall have a bio-based, formaldehyde-free binder and be UL GREENGUARD Gold certified.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - FIBERGLASS PRODUCTS

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:

1. Knauf Insulation.
2. Johns Manville Products Corp.
3. Owens-Corning Fiberglass Corp.
4. Manson Insulation.

2.2 PIPING INSULATION MATERIALS

A. Fiberglass Piping Insulation: ASTM C 547, Type 1 unless otherwise indicated.

B. Cellular Glass Piping Insulation: ASTM C552, Type II, Class 2.

C. Elastomeric Foam Piping Insulation: ASTM C 534, Type I.

D. Jackets for Piping Insulation: ASTM C 921 and ASTM C 1136, Type I (Vapor Barrier) for piping with temperatures below ambient, Type II for piping with temperatures above ambient. Type I may be used for all piping at Installer's option.

1. Encase pipe fittings insulation with one-piece pre-molded PVC fitting covers, fastened as per manufacturer's recommendations, ASTM D 1784.
2. Encase exterior piping insulation with aluminum jacket with weather-proof construction, ASTM C 1729.

E. Staples, Bands, Wires and Cement: As recommended by insulation manufacturer for applications indicated.

F. Adhesives, Sealers and Protective Finishes: As recommended by insulation manufacturer for applications indicated.

2.3 METAL PROTECTIVE JACKET

A. Sheet aluminum: ASTM C1729, 3003 alloy, H-14 temper, and 0.016 in. thick. Provide moisture barrier lining for service temperatures 60°F or less except where applied over a Type I or II jacket. Longitudinal lap shall be at least two inches wide.

B. Fitting covers: Factory fabricated from not lighter than 0.020 in. thick type 3003 sheet aluminum.

C. Bands: 3/4 in. wide aluminum on maximum 18 in. centers.

D. Provide metal jackets over insulation as follows:

1. All insulation exposed to outdoor weather.
2. Insulation exposed in building within five (5) ft. of the floor that connect to sterilizers, kitchen and laundry equipment. Seal without the use of screws or pop rivets. Provide aluminum angle ring escutcheons at wall, ceiling and floor penetrations.
3. A two-inch overlap is required at longitudinal and circumferential joints.

E. Provide PVC jackets, color coded per ASHRAE, over insulation as follows:

1. Piping exposed in the building.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

B. Thickness of insulation shall be as recommended by the manufacturer for the temperatures and pipe sizes involved, and in accordance with standards of NAIMA.

3.2 HVAC PIPING SYSTEM INSULATION

A. Insulation Omitted: Omit insulation on hot piping within radiation enclosures or unit cabinets; on cold piping within unit cabinets provided piping is located over drain pan; on heating piping beyond control valve, located within heated space; on condensate piping between steam trap and union; and on unions, flanges, strainers, flexible connections and expansion joints.

B. Sub-Freezing Piping (Below 0°F (-18°C)):

1. Application Requirements: Insulate the following subfreezing HVAC piping systems:

a. Low temperature refrigerant piping.

2. Insulate each piping system specified above with one of the following types and minimum thicknesses of insulation: (Check thickness' against ambient design conditions and recommendations of insulation material manufacturers)

a. Fiberglass: 1-1/2 in. thick for pipe sizes up to and including 2 in., 2 in. thick for pipe sizes over 2 in.

b. Cellular Glass: 2-1/2 in. thick for pipe sizes up to and including 2 in.; 3 in. thick for pipe sizes over 2 in.

C. Sub-Freezing Piping (0 to 39°F (-18 to 4°C)):

1. Application Requirements: Insulate the following subfreezing HVAC piping systems:

a. Refrigerant suction lines between evaporators and compressors. Brine refrigerant piping.

2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:

a. Fiberglass: 1 in. thick for pipe sizes up to and including 1 in., 1-1/2 in. thick for pipe sizes over 1 in.

b. Cellular Glass: 1-1/2 in. thick for pipe sizes up to and including 1 in.; 2 in. thick for pipe sizes over 1 in.

D. Cold Piping (40°F (4.4°C) to ambient)):

1. Application Requirements: Insulate the following cold HVAC piping systems:

a. HVAC chilled water supply and return piping.

b. HVAC make-up water piping.

c. Air conditioner condensate drain piping.

2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:

a. Fiberglass: 1 in. thick for pipe sizes up to and including 1-1/4 in.; 1-1/2 in. thick for pipe sizes over 1-1/4 in.; 1/2 in. thick for condensate drain piping.

b. Elastomeric Foam: 1 in. thick for pipe sizes up to 1-1/4 in.; 1-1/2 in. thick for pipe sizes over 1-1/4 in.; ½ in. thick for condensate drain piping.

E. Insulation of Piping Exposed to Weather: Protect outdoor insulation from weather by installing outdoor protective finish or jacketing as recommended by the manufacturer.

3.3 INSTALLATION OF PIPING INSULATION

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

B. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance of tests.

C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

D. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

E. Maintain integrity of vapor-retarder jackets on pipe insulation, and protect to prevent puncture or other damage.

F. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.

G. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.

H. Butt pipe insulation against pipe hanger insulation inserts. For hot pipes, apply 3 in. wide vapor barrier tape or band over the butt joints. For cold piping apply wet coat of vapor barrier lap cement on butt joints and seal joints with 3 in. wide vapor barrier tape or band.

I. Do NOT insulate over pipe hangers. If pipe hangers for piping to be insulated are not adequately sized for insulation to pass through the hanger, notify the General Contractor and Architect.

3.4 INSULATION EXPOSED TO WEATHER

A. Protect outdoor insulation from weather by installation of weather-barrier metal jacketing. Metal jacketing shall be Aluminum. It may be factory-applied or field applied. Joints shall be overtapped a minimum of 2 in. Securement shall be accomplished by using stainless steel bands. Any vapor-barrier jacket or coating under the metal jacketing shall not be disturbed or punctured by the use of screws or rivets on the outer jacket.

3.5 EXISTING INSULATION REPAIR

A. Repair damaged sections of existing mechanical insulation, both previously damaged or damaged during this construction period. Use insulation of same thickness as existing insulation, install new jacket lapping and sealed over existing.

3.6 PROTECTION AND REPLACEMENT

A. Replace damaged insulation that cannot be repaired satisfactorily, including units with vapor barrier damage and moisture-saturated units.

B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION

SECTION 23 09 23

BUILDING CONTROL SYSTEM (BCS)

PART 1 - GENERAL

1.1 GENERAL

A. All work shall be in accordance with Division 01 and Section 23 00 10 "BASIC MECHANICAL REQUIREMENTS".

1.2 SCOPE OF WORK

A. Furnish all labor, materials, tools, equipment, and services to extend the existing campus Energy Management and Control System (EMCS), to provide a fully integrated Building Control System (BCS) as indicated, in accordance with the Contract Documents.

B. The BCS shall fully integrate third-party manufacturers control subsystems (i.e., boilers, chillers, etc.), which shall be capable of operating in a standalone mode, while being software integrated to comprise the complete BCS.

C. Deliver the following features, hardware, and functions as a minimum:

1. One Network Control Panel (NCP) for each major piece of equipment such as chillers, boilers, cooling towers, etc.
2. One Application Specific Controller (ASC) for each air-handling unit, packaged rooftop unit, make-up air unit, fan coil unit, etc.
3. Integration to third-party manufacturers' microprocessor controllers, as specified herein.
4. Furnish and install all sensors, transducers, and controlled devices per this specification.
5. Furnish all automatic control valves and control dampers for installation by the Mechanical Installer. Furnish and install all control damper and control valve actuators.
6. All monitoring, controlling, optimizing, interfacing, reporting, archiving, operator interface and information formulation and other special packages as required by the Contract Documents, including but not limited to the following:
    a. Scheduled stop/start.
    b. Optimum start/stop.
    c. Run time totalization.
    d. Duty cycling.
    e. Power demand control.
    f. Load restoration following a fire alarm.
    g. Automatic alarm lockout.
    h. Password access control.
    i. Graphics display.
    j. Dynamic graphical trending.
    k. Historical data recording and reporting.

1.3 CONTRACTOR QUALIFICATIONS

A. An integrated BCS will only be considered for acceptance from the following companies:

1. Schneider Electric

B. The BCS shall be installed by competent mechanics and commissioned by competent technicians regularly employed by the equipment vendor.

C. Provide installation, calibration, and check-out of the stand-alone subsystems; as well as the complete operation of the integrated BCS, including graphics generation, implementation of point history feature and energy management applications.

D. Maintain local support facility with technical staff, spare parts inventory, and all necessary test diagnostic equipment.

1.4 REFERENCED STANDARDS, CODES, AND ORDINANCES

A. It is the responsibility of the Contractor to be familiar with all codes, rules, ordinances, and regulations of the authority having jurisdiction and their interpretations that are in effect at the site of the work.

B. All systems equipment, components, accessories, and installation hardware shall be new and free from defects and shall be UL listed where applicable. All components shall be in current production and shall be a standard product of the system or device manufacturer. Refurbished or reconditioned components are unacceptable. Each component shall bear the make, model number, device tag number (if any), and the UL label as applicable. All system components of a given type shall be the product of the same manufacturer.

1.5 SUBMITTALS

A. Provide submittal data as referenced in Division 01 and Section 23 00 10 of these Contract Documents.

B. Shop drawings shall include the installation details for all equipment to be furnished or provided under this Contract. At minimum, the shop drawings shall include details of:

1. BCS architecture schematic (riser diagram).
2. Interconnection and installation drawings and schedules, including bill of materials and sequences of operation.
3. Field panel layout, plan location and interconnection drawings and specification sheets.
4. Proposed panel loading and spare capacity.
5. Location and sizes for sleeves in walls and floors.
6. Instrumentation locations marked on Mechanical Drawings.
7. Schematic of monitored/controlled systems indicating device locations.
8. Device installation details.
9. Other documentation as appropriate.

C. Product data submittals shall include the specifications for all equipment and software to be furnished or provided under this Contract. In addition, the submittals shall include details of:

1. Software and special packages.
2. Computer equipment and terminal specification sheets.

3. Field sensors and instrumentation specification sheets.
4. Damper, valve and actuator specifications sheets.
5. Proposed graphic schematics of mechanical and other systems.
6. Wiring specifications.
7. Format of point/function log sheet.
8. Other documentation as appropriate.

PART 2 - PRODUCTS

2.1 VARIABLE VOLUME

A. Each of these units is a multiple zone, variable volume rooftop unit, draw-through type, equipped with supply fan, outside damper, relief damper, DX cooling coil, multiple DX compressors, an integral air-cooled condensing section, electric preheat, and variable frequency drives for the supply fan. Each of these units shall be equipped with an integral DDC controller and enthalpy economizer controller. The DDC controller shall provide the monitoring and control functions specified below. These controllers shall be integrated via software into the overall BCS to provide seamless operation of all unit controls.

B. Space temperature setpoints shall be as follows:

C. Occupied:

a. Cooling 74 deg F (adj.), with a user adjustable dead band of +/- 2.0 deg F (adj.).

b. Heating 68 deg F (adj.), with a user adjustable dead band of +/- 2.0 deg F (adj.).

2. Unoccupied:

a. Cooling 80 deg F (adj.), with a user adjustable dead band of +/- 2.0 deg F (adj.).

b. Heating 55 deg F (adj.), with a user adjustable dead band of +/- 2.0 deg F (adj.).

D. Occupied Mode

1. Occupancy mode time periods will be set via user adjustable schedule and will be activated/overridden via a network input.
2. If the outside air damper fails to open (the end switch measures if the damper is closed) an alarm point shall notify the BCS.

E. De-energized mode.

1. Supply fan shall be de-energized.
2. Condensing fans shall be de-energized.
3. Outside air damper shall be closed.
4. Relief air damper shall be closed.
5. Return damper shall be open.
6. Compressors shall be de-energized.
7. Electric heater shall be de-energized.

F. Normal operation mode.

1. Supply Fan

a. Supply fan shall be modulated to maintain the static pressure setpoint identified in the contract document equipment schedules.

2. Compressors
    a. Compressors shall be staged and cycled in sequence to maintain the supply air temperature setpoint, initially set at 55°F (adj.).
        1) Stage one cooling shall run for 5 minutes (adj.) prior to enabling stage two cooling.
3. Preheat Coil
    a. The preheat coil will modulate to maintain a supply air temperature to the cooling coil of 50°F (adj.)
4. Damper Positions
    a. The outside air damper shall be at the minimum occupied setpoint as determined by the TAB contractor.
    b. The mixed air damper shall be open to its maximum occupied setpoint as determined by the TAB contractor.
5. The return air damper shall be open 100% (adj.).
    a. The relief air damper shall be open to the minimum occupied setpoint.

G. Economizer Mode
1. When the system is in normal operating mode, and the outside air enthalpy is lower than the return air enthalpy, and the outside air temperature is greater than 45°F (adj.), the system shall enter economizer mode.
2. When in economizer mode, the compressors and electric preheat coil will continue to operate as if in normal operating mode. The supply fan shall operate as if in normal operating mode.
3. If the system is in economizer mode, and the outside air temperature is greater than the supply air temperature set point, the economizer damper shall be open 100%, the return air damper shall be open to its maximum allowable position, the relief air damper shall be open to its maximum allowable position, and the mixed air damper shall be closed.
4. If the system is in economizer mode and the outside air temperature falls below the supply air temperature set point, the return air and economizer dampers shall be modulated in order to maintain the supply air temperature set point.
5. If the system is in economizer mode and the outside air temperature falls below 45°F (adj.), or the outside air enthalpy is higher than the return air enthalpy, the system will return to the normal operating mode.
6. Provide auto on off software function such that the Operator can override the economizer cycle operation from the associated VDU graphic.
7. Provide an Operator adjustable dead band between the economizer and normal operating modes, initially set at 4 Btu/lb.

H. Supply Air Temperature Reset

1. If no VAV terminal units are above 50% (adj.), the system will reset the supply air temperature setpoint. The setpoint will be incrementally reset up at a rate of 1°F (adj.) every 10 minutes until at least one VAV terminal unit is opened up to 75% (adj.) or greater. The maximum supply air temperature setpoint shall be 58°F (adj.).
2. If at least one VAV terminal unit is at 90% (adj.) or greater, and the supply fan static pressure reset sequence is not activated, the supply air temperature setpoint shall be reset down at a rate of 1°F (adj.) every 10 minutes until all VAV terminal units are at 80% (adj.) or lower. The minimum supply air temperature set point shall be 52°F (adj.).

I. Dehumidification Mode
1. If the humidity in any space served by the AHU rises above 60% relative humidity (adj.), the system will enter dehumidification mode.
2. The cooling coil valve shall be modulated to maintain a supply air temperature of 52°F (adj.) at the cooling coil and will not be reset until the system exits dehumidification mode.
3. The system shall exit dehumidification mode when the relative humidity falls below 55% (adj.).

J. Controller Failure mode.
1. Compressors shall be de-energized.
2. Electric heater shall be de-energized.
3. Condensing fans shall be de-energized.
4. Supply fan shall be de-energized.
5. Outside air damper shall be closed.
6. Relief air damper shall be closed.
7. Appropriate alarm shall be generated.

2.2 POWERED EXHAUST (PACKAGED)

A. When in occupied mode, the unit will modulate its fan in order to maintain a minimum of -0.01 in of water (adj.) pressure difference between the room and the corridor.

B. When in unoccupied mode, the unit will be de-energized.

2.3 VARIABLE AIR VOLUME TERMINAL UNIT WITH REHEAT

A. De-energized mode
1. The terminal unit damper shall be closed to its minimum allowable position as determined by the TAB contractor.
2. The reheat coil shall be de-activated.

B. Normal operating mode
1. The terminal unit’s damper shall be modulated to maintain the desired space temperature.
2. If the terminal unit’s damper is at its minimum allowable position and the space temperature falls below the desired space temperature, the reheat coil shall be modulated to maintain the desired space temperature.

3. If the terminal unit's reheat coil is fully activated and the space temperature remains below the setpoint, the terminal unit's damper shall be modulated up to the maximum heating supply airflow as set by the TAB contractor to maintain the desired space temperature.

C. Temperature Averaging

1. For units serving multiple spaces with temperature sensors, an average space temperature will be used to control the VAV terminal unit. The space temperature setpoint is an owner adjustable point for these VAV terminal units initially set at 74°F (adj.).
2. If the current space temperature in any space served by the VAV terminal unit rises to 5°F (adj.) above the setpoint, modulate the damper of the terminal unit in order to provide cooling until all spaces are within 2°F (adj.) above the setpoint.
3. If the current space temperature in any space served by the VAV terminal unit falls to 5°F (adj.) below the setpoint, modulate the damper and reheat coil of the terminal unit in order to provide heating until all spaces are within 2°F (adj.) below the setpoint.

D. BCS Component failure mode

1. If the space temperature is greater than 4°F from the desired space temperature, and the terminal unit has not been in de-energized mode within the last 120 minutes, generate an appropriate alarm.

PART 3 - EXECUTION

3.1 GENERAL

A. All grounding, wiring, selection of components and installations shall conform to the National Electrical Code with amendments to the date of issue of this specification.

B. The installation shall conform to each manufacturer's recommended procedures and to all applicable codes, statutes and ordinances and to the Contract Documents. In each and every instance of application, the code, regulation, statute, by-law or specification having the most stringent requirements shall apply.

C. All installations to be performed by skilled and certified technicians.

D. All equipment installed shall be mechanically stable and, as necessary, fixed to wall or floor. Provide anti-vibration mounts, if required, for the proper isolation of the equipment.

E. Install equipment so as to allow for easy maintenance access. Install equipment such that it does not interfere in any way with across to adjacent equipment and personnel traffic in the surrounding space.

F. Install equipment in locations providing adequate ambient conditions for its specified functioning, allowing for adequate ventilation and with no condensate traps.

G. All components placed in areas of high humidity or potentially high humidity must be adequately protected.

H. The Contractor shall for each handling system with 2000 CFM airflow (nominal 5 Tons) or greater, install UL listed ionization smoke detectors in the main return air duct, and/or where shown on the drawings. Smoke detectors may be omitted from the main supply air duct when explicitly not required by local code. Smoke detectors furnished by Division 26. Refer to Section 23 05 12. Connect the detectors into the control circuit to stop the fan in the event of the presence of smoke.

1. System airflow includes the total airflow of all units serving any single space and all units connected to the same return air plenum.

3.2 CONDUIT, WIRING, CABLING AND FITTINGS

A. The installation shall conform to the Division 23 and 26 Contract Documents for this project.

B. All wires and cables for powering the BCS as provided shall be:

1. Ninety-eight (98) percent conductivity copper.
2. A minimum of #12 AWG for branch 120 VAC power circuits.
3. A minimum of #14 AWG for DO motor control circuits.
4. A minimum of #18 AWG for sensing, transmitter, DO (except motor control circuits) and AO control circuits. Where manufacturers recommend a heavier conductor, then the BCS Installer shall comply with the manufacturer's recommendation.
5. A minimum of #20 AWG for communication trunk, shielded and grounded at a single end.
6. Stranded copper conductors throughout for #18 AWG and smaller diameter wire.
7. Continuously color coded insulation in accordance with Section 26 05 19 entitled "Wire and Cable".

C. All cabling shall be plenum rated cable and shall be as specified above with the following additional requirements:

1. All plenum rated wire and cable shall be a minimum of #18 AWG and shall be shielded.
2. Cable jacket shall have a minimum thickness of 0.015 in. and shall be bright orange, red, yellow or other bright, distinctive color. Coordinate jacket color with other trades.
3. Plenum wiring and cabling shall be routed through cable rings. Cable rings shall be suitably spaced to properly support plenum cabling and shall be attached to ductwork hangers or structure as applicable.
4. Plenum cable shall be as manufactured by Belden, Kynar, Dekoron or approved equal.

D. Smaller gauge wiring shall be acceptable if certified by the equipment manufacturer. If complications arise, however, due to wiring size, replace the wire at no additional cost to the Owner.

E. The sizing and provision of conduit and type of wire for the main BCS trunk wiring are the design responsibility of the BCS Installer.

F. Obtain and pay for all electrical inspection fees related to the work of this section.

G. Perform circuit tests using qualified personnel only. Provide necessary instruments and equipment to demonstrate that:

1. All circuits are continuous and free from short circuits and grounds.

2. All circuits are free from unspecified grounds; that resistance to ground of all circuits is no less than 50 megohms.

H. Provide complete testing for all wiring installed or utilized as part of this work. Provide all equipment, tools, and personnel as necessary to conduct these tests.

I. Provide complete grounding of all power and signal wiring so as to ensure system integrity of operation.

J. NCP/ASC shall not be mounted in-line with vertical conduit but shall be connected off to the side of the vertical conduit by suitably pitched conduit such that any condensed moisture in the vertical conduit cannot enter the NCP/ASC enclosures.

K. All analog and digital input points and communication cables shall have shielded wiring. Non-shielded wiring may only be provided upon certification from the manufacturer that non-shielded wiring will not cause degradation of system performance and will not render the system more susceptible to damage. However, if complications arise from the use of non-shielded wiring, replace the wiring at no additional cost to the Owner.

L. BCS wiring shall not run in the same conduit as power wiring of any voltage.

M. Suitably coated wire may be used in ceiling spaces and in tenant wall partitions without conduit where local codes permit and the cable jacks and insulation have been accepted under the provisions of the National Electrical Code and have been classified by UL, Inc. For use without conduit in air plenums. Elsewhere use Electrical Metallic Tubing (EMT).

N. Sleeves shall be provided by the BCS Installer where required and shall meet the requirements detailed in the Division 26 Contract Documents for this project.

O. All wiring shall be marked in accordance with the National Electrical Code. Provide the labeling of wire at every termination. Each wire shall be identified which uniquely identifies each wire and which corresponds to the shop Drawings and as-built Drawings provided under this Contract.

3.3 EQUIPMENT, INSTALLATION

A. Temperature sensing wells.

1. Provide list with shop drawing of well locations to Mechanical Installer.

B. Locate temperature sensors, humidity sensors, thermostats, and humidistat for room control immediately as shown on the mechanical drawings. Prior to installation, coordinate sensor and/or thermostat locations with the Owner and Architect.

1. Prior to installation, coordinate sensor and/or thermostat locations with Owner’s Representative.

C. Mount local control panels on at convenient locations adjacent to equipment served.

1. Mount all relays, etc., internal to the temperature control panels.

2. Tag each instrument corresponding to symbols used on control diagrams.

D. Mounting of controllers on air handling units shall not be allowed.

E. Furnish all control valves (globe and butterfly, as applicable) to the Mechanical Installer. Mechanical Installer to install control valves per the valve manufacturer’s recommendations.

3.4 COMMISSIONING

A. BCS shall be installed and commissioned by factory-trained technicians skilled in the setting and adjustment of BCS equipment used in this project. This technician is to be experienced in the type of systems associated with this BCS,

B. Perform a complete and detailed calibration and operational check for each individual point and for each individual function as contained within the BCS. These checks shall ensure that all equipment, software, network elements, modules and circuits as provided under the terms of this contract are functioning as per the Contract Documents. Such checks shall be carried out with the use of point/function log sheets. Point/function sheets are to be prepared by the Contactor and submitted to the Engineer for the approval of content and format. Such calibration and operation checks shall be performed prior to the commencement of final tests on completion for any relevant system part. The point/function logs shall, at minimum, include the following:

1. Identification of each point by BCS point name and expanded descriptor.
2. Indication of BCS value/status, field-tested value/status, and deviation between the BCS and field-tested value/status.
3. Confirmation of system safeties operation.
4. Confirmation of proper failure modes of motors, dampers, valves, etc.
5. Confirmation of proper tuning of PID control loops.
6. Confirmation of proper sequence of operation performance.
7. Manufacturer, model number and accuracy of test instruments used.
8. Date of testing/verification and name of individuals performing the tests.

C. At time of final observation, demonstrate the sequence of operation for each system to the Owner and Engineer. Perform system demonstration as directed by Owner and Engineer.

3.5 TRAINING

A. Provide a minimum of 8 hours of instructions to Owner's personnel in the operation and maintenance of the control system. Provide training after the system has been installed and commissioned. Training shall be on-site, using the installed BCS as the basis for training. Provide Training Manuals and O&M Manuals for students attending on-site training.

3.6 WARRANTY

A. At completion of final test of installation and acceptance by Owner, provide any service incidental to proper performance for a period of one year.

B. Equipment shall be warranted for one year (including defects in workmanship and material) under normal use and service. During warranty period supplier shall also replace or repair, free of charge, any equipment proven to be defective in workmanship or material.

C. Certain electronic devices not manufactured by the BCS supplier such as computers, etc., shall carry the original manufacturer's warranty. Pass any registration and warranty documents and warranty rights to the Owner.

D. All software upgrades, enhancements or revisions that are initiated by the BCS manufacturer up to the time of expiration of the warranty period shall be provided at no additional cost to the Owner.

END OF SECTION

SECTION 23 09 93

SEQUENCE OF OPERATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 specifications, apply to this section as well as Section 23 00 10 "BASIC MECHANICAL REQUIREMENTS".

1.2 DESCRIPTION OF WORK

A. The work required by this Section shall include the provision of all labor, materials, documentation and services as required by the Contract Documents for those aspects of the BCS installation relating to:

1. The implementation of the sequences of operation as detailed herein.

1.3 GENERAL

A. In the descriptions of the sequences of operation to be executed by the BCS, the following shall apply:

1. Where modulation of a valve or damper is referred to then it shall mean the direct digital control of the valve or damper based on a control algorithm resident in the BCS software at the NCP. Unless noted otherwise the control algorithm shall be PID control. Choose the control constants so as to provide optimum loop response.
2. An Operator having the required level of password access shall be able to modify the Operator changeable or definable parameters on-line from an I/O device such that the monitoring and control functions of the BCS shall not be affected during the period of the change. The mechanism by which the change is made shall be simple and shall be adequately described in the Operator's manuals. Where setpoints for control parameters such as temperature, humidity, Operator selection of lead/lag equipment, and modes of operation are referred to in this Section they shall be Operator changeable on-line on the associated VDU graphic.
3. Where the sequences refer to the start/stop of a system this shall be initiated either by an Operator manually entered command or automatically by a software routine such as "Optimum Stop/Start", "Power Demand Control", "Programmed Stop/Start", etc. or by way of an interlock in the sequences of operation to other equipment or events.
4. When the motor controller provided by Division 23 or Division 26 is equipped with a HOA, the motors shall only be controlled by the BCS when the HOA switch is in the auto position.
5. High differential pressure switches, smoke and fire detectors and interlocked dampers (motorized control damper, smoke damper or combination fire/smoke damper) shall be wired to shut down motors when the HOA switch is in both the hand and auto positions. It shall not be possible for the BCS to override these or any other safety devices or any fire alarm system control functions.
6. Refer to the Point Definition Sheets, which form part of these Contract Documents, to facilitate the interpretation of the sequences of operation as defined in this Section.

7. Provide additional I/O points and instrumentation, whether or not such points are indicated in the Point Definition Sheets, if they are required in order to attain the requirements of the Contract Documents.
8. Where fans and dampers (control dampers, smoke dampers or combination fire/smoke dampers) are to be interlocked, provide hardwire interlocks between the motor starter and damper or software interlocks such that the damper shall be driven open when the motor is required to start. Motor start up shall not occur until the damper end switch indicates the damper is in the full open position.
9. The BCS shall open the BCS motor control relay where the BCS commanded and monitored status of the motor differ.
10. On air handling systems that are equipped with heating and cooling coils, the heating and cooling setpoints shall be selected to avoid simultaneous heating and cooling.
11. Where there are fans not identified within the sequence of operation or point definition sheets that provide supply and/or exhaust air that are not controlled by way of a thermostat, they shall be hardwire interlocked to the controlling device as indicated in the Division 23 or Division 26 Contract Documents. The supply fans shall be hardwire interlocked with their associated exhaust fan (if applicable) to operate simultaneously. The dampers (control damper, smoke damper or combination fire/smoke damper) shall be hardwire interlocked with the fans by way of end switches such that the fans cannot operate when the damper is not fully open. The damper status shall not be monitored by the BCS.

PART 2 - PRODUCTS

2.1 LIGHTING CONTROL

A. The Division 26 Subcontractor shall provide G.E. RR7 or equivalent lighting control relays on the lighting circuits to be controlled by the BCS. The Division 26 Subcontractor shall mount the relays in a cabinet adjacent to the lighting power panels in the electrical rooms adjacent to the associated zone. The Division 26 Subcontractor shall wire the lighting relays to a terminal strip at the relay cabinet. This Subcontractor shall wire from this terminal strip to the BCS. Provide one (1) override switch at each relay cabinet to allow for local override control of all the zones within the associated relay cabinet regardless of the status of the BCS.

B. Refer to the Division 26 lighting drawings of the location and quantities of lighting circuits, and relay cabinets. Lighting control zones shall be as defined in the Division 26 lighting drawings.

2.2 VARIABLE VOLUME PACKAGED ROOFTOP UNIT

A. Each of these units is a semi-custom, single zone, variable volume rooftop unit, draw-through type, equipped with supply fan, return fan, outside damper, return air damper, relief damper, DX cooling coil, electric heating coil, multiple DX compressors, an integral air-cooled condensing section and variable frequency drives for the supply and return fans. Each of these units shall be equipped with an integral DDC controller and enthalpy economizer controller The DDC controller shall provide the monitoring and control functions specified below. These controllers shall be integrated via software into the overall BCS to provide seamless operation of all unit controls.

B. De-energized mode.
   1. Supply fan shall be de-energized.
   2. Return fan shall be de-energized
   3. Outside air damper shall be closed.
   4. Return air damper shall be open.
   5. Relief air damper shall be closed
   6. Compressors shall be de-energized.
   7. Condensing fans shall be de-energized.
   8. Electric heating coil shall be de-energized.

C. Economizer mode.
   1. Supply fan and return fan shall be energized.
   2. The supply fan speed shall be modulated to maintain the duct static pressure setpoint as defined in the Normal operation mode.
   3. The return fan speed shall be modulated to maintain the space static pressure setpoint. Coordinate the space static pressure setpoint with Test and Balance Contractor
   4. The internal enthalpy economizer controller shall compare the outside air heat and the return air heat and shall modulate the outside air damper, return air damper and relief air damper to provide the lowest heat content air to the rooftop unit.
   5. If the mixed air temperature is below 40 degrees F, the outside air damper and relief air damper shall fully close, and the return air damper shall fully open.
   6. When the outside air heat is lower than the return air heat, but the space temperature setpoint cannot be satisfied, then the compressor(s) shall be staged/cycled to provide supplemental cooling as needed to maintain the supply air temperature setpoint.
   7. If the outside air heat is higher than the return air heat, the RTU shall operate under the normal operation mode.
   8. Provide an adjustable deadband between the economizer and normal operating modes, initially set at 4 degrees F.

D. Normal operation mode.
   1. Supply fan and return fan shall be energized.
   2. Outside air damper and relief air damper shall close to the minimum position.
   3. Return air damper shall be opened to a pre-determined position. Coordinate exact damper position with the Test and Balance Contractor.
   4. Compressors shall be staged and cycled and the electric heat shall be modulated in sequence to maintain the supply air temperature setpoint, initially set at 55°F.
   5. The supply fan speed shall be modulated to maintain the supply duct static pressure setpoint. Locate the duct static pressure sensor as directed by the Test and Balance Contractor. Coordinate the exact duct static pressure setpoint with the Test and Balance Contractor.

6. The return fan speed shall be modulated to maintain the mixed air plenum static pressure setpoint. Coordinate exact mixed air plenum static pressure setpoint with the Test and Balance Contractor

E. Controller Failure mode.

1. Supply fan shall be de-energized.
2. Return fan shall be de-energized
3. Outside air damper shall be closed.
4. Return air damper shall be open.
5. Relief air damper shall be closed.
6. Compressors shall be de-energized.
7. Condensing fans shall be de-energized.
8. Electric heating coil shall be de-energized.
9. Appropriate alarm shall be generated.

2.3 MULTI-ZONE AIR HANDLING UNITS

A. The existing multizone AHU consists of a constant volume factory built air handling unit with chilled water cooling coil in the cold deck, a hot water heating coil in the zone ductwork, outside air damper and return air damper and zone face and bypass mixing dampers (heating/coiling mixing damper). New VAV terminal units with electric reheat shall be provided in zone branches 4 and 5. The existing CV zones 1, 2, 3 and 6 shall remain constant volume. Mixing damper shall modulate as required to maintain desired zone space temperature.

B. De-energized mode.

1. Supply fan shall be de-energized.
2. Outside air damper shall be closed.
3. Cold deck valve shall be closed.
4. Hot deck valve shall be open.
5. Zone face and bypass dampers shall be in the full bypass position.

C. Normal operation mode.

1. Supply fan shall be energized.
2. Cooling coil valve shall be modulated to maintain a cold deck temperature of 55f., but shall be gradually increased by means of a suitable algorithm until such time as one of the zone face and bypass dampers is fully open to flow through the cold deck.
3. Outside air damper shall be opened to the minimum outside air position.
4. Zone heating coil valves shall be modulated in sequence with the zone face and bypass dampers to maintain a zone space temperature setpoint of 72 deg. f. for heating and 75 deg. f. for cooling. The zone heating coil valve shall not be opened to the coil until the associated zone mixing dampers are in the full bypass position and there is still a call for heating in the zones.

D. Cold deck - cooling supply air temperature setpoint - optimized:

1. The cooling supply air temperature setpoint shall be reset using a trim and respond algorithm based on zone cooling airflow requirements (damper position in the VAV boxes). If there is a demand for cooling then the setpoint shall be reset to a lower value (adj.). If the demand for cooling decreases then the setpoint shall reset to a higher value (adj.). Once the zones are satisfied then the setpoint shall gradually moderate over time to reduce cooling energy use.
2. The supply air temperature setpoint shall be reset based on zone cooling requirements as follows:
    a. The initial supply air temperature setpoint shall be 55°f (adj.).
    b. As cooling demand increases, the setpoint shall incrementally reset down to a minimum of 53°f (adj.).
    c. As cooling demand decreases, the setpoint shall incrementally reset up to a maximum of 72°f (adj.).

E. Heating coils - heating supply air temperature setpoint - optimized:
1. The heating supply air temperature setpoint shall be reset using a trim and respond algorithm based on zone heating requirements (damper position in the VAV boxes). If there is a demand for heating then the setpoint shall be reset to a higher value (adj.). If the demand for heating decreases then the setpoint shall reset to a lower value (adj.). Once the zones are satisfied then the setpoint shall gradually moderate over time to reduce heating energy use.
2. The supply air temperature setpoint shall be reset based on zone heating requirements as follows:
    a. The initial supply air temperature setpoint shall be 82 deg F (adj.).
    b. As heating demand increases, the setpoint shall incrementally reset up to a maximum of 90 deg F (adj.).
    c. As heating demand decreases, the setpoint shall incrementally reset down to a minimum of 72°f (adj.).

F. High static shutdown:
1. The unit shall shut down and generate an alarm upon receiving a high static shutdown signal.

G. Return air smoke detection:
1. The unit shall shut down and generate an alarm upon receiving a return air smoke detector status.

H. Supply fan:
1. The supply fan shall run anytime the unit is commanded to run, unless shutdown on safeties.
2. Alarms shall be provided as follows:
    a. Supply fan failure: commanded on, but the status is off.
    b. Supply fan in hand: commanded off, but the status is on.
    c. Supply air duct static pressure control:

1) The controller shall measure duct static pressure and modulate the supply fan VFD speed to maintain a duct static pressure setpoint. The speed shall not drop below 30% (adj.). The static pressure setpoint shall be reset based on zone cooling requirements.

2) The initial duct static pressure setpoint shall be as established by the test and balance contractor (adj.).

3) As cooling demand increases, the setpoint shall incrementally reset up to a maximum setpoint as established by the test and balance contractor (adj.).

4) As cooling demand decreases, the setpoint shall incrementally reset down to a minimum as established by the test and balance contractor (adj.).

5) Alarms shall be provided as follows:

a) High supply air static pressure: if the supply air static pressure is 25% (adj.) greater than setpoint.

b) Low supply air static pressure: if the supply air static pressure is 25% (adj.) less than setpoint.

c) Supply fan VFD fault.

I. Return fan:

1. The return fan shall run whenever the supply fan runs.

2. Alarms shall be provided as follows:

a. Return fan failure: commanded on, but the status is off.

b. Return fan in hand: commanded off, but the status is on.

c. Return fan runtime exceeded: status runtime exceeds a user definable limit (adj.).

d. Return fan VFD fault.

e. Return plenum static pressure control:

1) The controller shall measure return plenum static pressure and modulate the return fan VFD speed to maintain a return plenum static pressure setpoint as established by the test and balance contractor (adj.). The return fan VFD speed shall not drop below 20% (adj.).

2) Alarms shall be provided as follows:

a) High return plenum static pressure: if the return air plenum static pressure is 25% (adj.) greater than setpoint.

b) Low return plenum static pressure: if the return air plenum static pressure is 25% (adj.) less than setpoint.

J. Minimum outside air ventilation - carbon dioxide (CO2) control:

1. When in the occupied mode, the controller shall measure the return air CO2 levels and modulate the outside air dampers open on rising CO2 concentrations, overriding normal damper operation to maintain a co2 setpoint of 750 ppm (adj.).

K. Economizer:

1. The controller shall measure the mixed air temperature and modulate the economizer dampers in sequence to maintain a setpoint 2°f (adj.) less than the supply air temperature setpoint. The outside air dampers shall maintain a minimum adjustable position of 20% (adj.) open whenever occupied.
2. The economizer shall be enabled whenever:
    a. Outside air temperature is less than 58 Ddeg F (adj.).
    b. And the outside air enthalpy is less than 22btu/lb (adj.)
    c. And the outside air temperature is less than the return air temperature.
    d. And the outside air enthalpy is less than the return air enthalpy.
    e. And the supply fan status is on.
3. The economizer shall close whenever:
    a. Mixed air temperature drops from 40 deg F to 35 deg F (adj.)
    b. Or the freezestat (if present) is on.
    c. Or on loss of supply fan status.
4. The outside and exhaust air dampers shall close and the return air damper shall open when the unit is off. If optimal start up is available the mixed air damper shall operate as described in the occupied mode except that the outside air damper shall modulate to fully closed.

L. BCS component failure mode.
1. Supply fan shall be de-energized.
2. Outside air supply air damper shall be closed.
3. Cooling coil valve shall be closed.
4. Zone face and bypass dampers shall be in the full bypass position.
5. Zone hot water coil valves shall be in the bypass position.
6. Generate an appropriate alarm.

2.4 VARIABLE AIR VOLUME TERMINAL UNIT

A. Venturi control valves with electric reheat will be installed in the ductwork served by RTU-1. The design intent is for this system to utilize and AHU supply air temperature reset when all of the VAV boxes are either fully open or closed. These boxes shall connect to an integral DDC controller. The DDC controller provides the monitoring and control functions specified below. These controllers are integrated via software into the overall BCS to provide seamless operation of all unit controls.

B. De-energized mode.
1. Zone damper shall be closed to the minimum position.
2. Electric reheat coil shall be de-energized.

C. Normal operation mode.
1. The control valve zone damper position shall modulate as required to maintain the desired space temperature.

2. If the space temperature drops below 72 deg F (adj.), and the damper is at a minimum position then the electric heating coil shall be energized. Unit is provided with an SSR controller to step (on 5-min. (adj.) intervals) the heater capacities up to the full scheduled kw. Control system shall increase heater output until desired space temperature is achieved.
3. If the space temperature exceeds the desired space temperature (72 deg F adj), then the electric heating coil shall be de-energized.

D. BCS component failure mode.

1. If the space temperature is greater than 4 deg F from the desired space temperature, generate an appropriate alarm.

PART 3 - INSTALLATION - NOT USED

END OF SECTION

SECTION 23 21 13.23

HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of hydronic piping work is indicated on drawings and schedules, and requirements of this section.

B. This section includes pipe, fittings, and valves for hydronic piping systems installed in the project as follows:

1. Chilled Water.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of hydronic piping products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with hydronic piping work similar to that required for project.

C. Codes and Standards:

1. ASME Compliance: Fabricate and install hydronic piping in accordance with ASME B31.9 "Building Services Piping".

2. IMC Compliance: Fabricate and install hydronic piping in accordance with “International Mechanical Code.”

1.3 SUBMITTALS

A. Provide the following submittals in accordance with Division 01 and Section 23 00 10.

B. Product Data: Submit manufacturer's technical product data and installation instructions for hydronic piping materials and products.

C. Shop Drawings: Submit scaled layout Drawings of hydronic piping and fittings including, but not necessarily limited to, pipe and tube sizes, locations, elevations, and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spatial relationship between piping and proximate equipment.

D. Submit certificates as listed below:

1. Test Certificates of Approval for Piping Systems.

E. Record Drawings: At project closeout, submit Record Drawings of installed hydronic piping and piping products, in accordance with requirements of Division 01.

F. Maintenance Data: Submit maintenance data and parts lists for hydronic piping materials and products. Include this data, product data, shop drawings, and record Drawings in maintenance manual; in accordance with requirements of Division 01.

1.4 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS - GENERAL

A. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements.

B. Provide materials and products complying with ASME B31.9 Code for Building Services Piping where applicable, base pressure rating on hydronic piping systems maximum design pressures.

C. Provide sizes and types as required to match piping and equipment connections; provide fittings of materials which match pipe materials used in hydronic piping systems.

D. Where more than one type of material or product is indicated, selection is Installer's option.

2.2 BASIC PIPES AND PIPE FITTINGS

A. Hydronic Piping:

1. Pipe Size 2 in. and Smaller: ASTM A53 black steel pipe; Schedule 40; ASTM A126 Fittings Class 125 cast-iron with ANSI B16.4 threaded joints.
2. Tube Size 3 in. and Smaller: ASTM B88 copper tube; Type L, hard-drawn temper; wrought-copper fittings, ANSI/ASME B16.27 with soldered joints, ANSI/ASTM B32, Grade 95TA.
3. Pipe Size 2-1/2 in. and Larger: ASTM A53 black steel pipe; Schedule 40; wrought-steel butt welding standard weight fittings, ASTM A234 and ANSI/ASME B16.9 with welded joints, ANSI/ASME B16.25.
4. Pipe Size 2-1/2 in. and Larger: Black steel pipe; Schedule 40, ASTM A53 grooved fittings with mechanical grooved couplings.
5. Pipe Run within Concrete Construction: Copper tube; Type K, soft annealed temper; no joints or fittings allowed. Sleeve tube with continuous length of 3/8 in. minimum thickness of flexible unicellular insulation.
6. Hydronic Drain Piping: Copper pipe; ASTM B306, DWV fittings; ANSI/ASME B16.3, cast bronze, or AWSI/ASME B16.29, wrought copper. Joints: ANSI/ASTM B32, solder, Grade 50B.

2.3 FLANGES, UNIONS AND COUPLINGS

A. Pipe Size 2 in. and under: 150 psig malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, soldered joints.

B. Pipe Size Over 2 in.: 150 psig forged steel slip-on flanges for ferrous piping; bronze flanges for copper piping; gaskets suitable for intended service – NO ASBESTOS GASKET MATERIAL ALLOWED.

C. Grooved and Shouldered Pipe End Couplings: Malleable iron housing clamps to engage and lock, designed to permit some angular deflection, contraction and expansion; “C” shape composition sealing gasket; steel bolts, nuts, and washers; galvanized couplings for galvanized pipe.

1. Acceptable Manufacturers:

a. Apollo Shurjoint
b. Gruvlok (Anvil International)
c. Tyco (Grinnell Mechanical Products)
d. Victaulic

D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, and water impervious isolation barrier.

2.4 BASIC VALVES

A. Ball Valves: For shutoff and throttling.

1. Ball valves 2 in. and less: MSS SP-72, rated for 200 psig minimum water pressure, full port, forged brass, bronze or stainless steel body, 316 or 304 stainless steel ball and stem, reinforced Teflon seats and seals, threaded or soldered connections. Throttling valves shall be provided with memory stops (for establishing any setpoint from 0-100% flow).

a. Acceptable Manufacturers and Models:

1)	Apollo	77-100 Series
2)	Jomar	T-100-SS
3)	KITZ	68M
4)	Nibco	T-585-70-66
5)	Victaulic	Series 722
6)	Watts	B-6080, B-6081

B. Butterfly Valves: For shutoff and throttling.

1. Butterfly valves 2-1/2 in. and larger: MSS SP-67, rated for 200 psig minimum water pressure, full lug style with threaded connections (rated for dead end service), iron body, stainless steel stem, EPDM seat material, gear operator with wheel, for flanged connections. Throttling valves shall be provided with memory stops (for establishing any setpoint from 0-100% flow).

a. Acceptable Manufacturers and Models:

1)	Apollo	LD141
2)	Crane	42
3)	Jomar	600/900
4)	KITZ	6123E, 6121E
5)	LD-2000-3 (Lever operated)	
6)	LD-2000-5 (8" and above gear operated)	
7)	Milwaukee	ML Series
8)	Stockham	LG-522
9)	Victaulic	Vic-300 MasterSeal
10)	Watts	BF-03

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Examine areas and conditions under which hydronic piping systems materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

B. Prior to and during the installation of grooved piping systems, the grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and the installation of all grooved-end products. The manufacturer's representative shall periodically visit the jobsite to review and inspect installations. Contractor shall remove and replace any joints deemed improperly installed. All grooving tools and products shall be of the same manufacturer.

3.2 INSTALLATION OF HYDRONIC PIPING

A. General: Install hydronic piping in accordance with the following requirements:

1. Install eccentric reducers where pipe is reduced in size in direction of flow, with tops of both pipes and reducer flush.
2. Install piping with 1/32 in. per ft. (1/4%) upward slope in direction of flow.
3. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.
4. Install dielectric connections wherever joining dissimilar metals.

B. Roof penetrations through metal roofs by the Plumbing or Mechanical Contractor will be required to have written approval by the Roofing Contractor.

3.3 INSTALLATION OF VALVES

A. Provide ball or butterfly valves for shutoff service as follows:

1. On inlet and outlet of each mechanical equipment item, and on inlet of each hydronic terminal, and elsewhere as indicated.
2. As drain valves on each mechanical equipment item located to completely drain equipment for service or repair. Install at base of each riser, at base of each rise or drop in piping system, and elsewhere where indicated or required to completely drain hydronic system.

B. Provide globe, ball, or butterfly valves for throttling service as follows:

1. On outlet of each hydronic terminal, and elsewhere as indicated.

3.4 EQUIPMENT CONNECTIONS

A. General: Connect hydronic piping system to mechanical equipment as indicated, and comply with equipment manufacturer's instructions where not otherwise indicated. Install shutoff valve and union on supply and return, drain valve on drain connection.

3.5 TESTING

A. General: Furnish pumps, gauges, equipment, and personnel required, and test as necessary to demonstrate the integrity of the furnished installation.

B. Pressure Piping: Hydrostatically test and make tight at 1-1/2 times the normal operating pressure and not less than 150 psig. Repair leaking joints and retest.

C. Gravity Piping: Unless otherwise directed, plug all openings and fill with water to a height equal to highest connected equipment. Allow to stand one hour. Remake leaking joints and retest.

D. Tests and Test Procedures shall be witnessed and approved by the Architect.

E. After completion and approval of testing, submit "Test Certificates of Approval" for heating water piping systems stating that all test results are satisfactory. Certificates of Approval must be signed by Contractor and Architect.

3.6 CLEANING

A. Cleaning, Flushing and Inspecting: Flush hydronic piping with potable water until the system can operate for eight (8) hours without partial build-up in strainers.

B. Chemical Treatment: Refill hydronic piping systems, adding caustic soda to maintain pH of 8.0 to 8.5 and sodium sulfate in amount of 1/3 caustic soda or to maintain residual of 30- to 40-ppm in system. Add trisodium phosphate to make hardness of 0-ppm and residual of approximately 30-ppm in system. Repeat measurements daily with system under full circulation and apply chemicals to adjust levels until no change is apparent.

1. Coordinate chemical treatment of the hydronic systems after installation of new piping and filling/re-filling of system with the Owner’s Water Treatment Supplier. The additional chemicals required due to cleaning and filling/re-filling of the hydronic systems are a part of this project, and the responsibility of the Contractor.

3.7 TESTING, ADJUSTING AND BALANCING

A. Test, adjust and balance hydronic systems in accordance with requirements of Section 23 05 93.

END OF SECTION

SECTION 23 23 00
REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of refrigerant piping work is indicated on drawings and schedules, and by requirements of this section.

B. This section includes pipe, fittings and valves for refrigerant piping systems installed in the project.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of refrigerant piping products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with refrigerant piping work similar to that required for project.

C. Codes and Standards:

1. ANSI Compliance: Fabricate and install refrigerant piping in accordance with ANSI B31.5 "Refrigeration Piping", and extend applicable lower pressure limits to pressures below 15 psig.
2. IMC Compliance: Fabricate and install refrigerant piping in accordance with “International Mechanical Code.”
3. ASHRAE Compliance: Fabricate and install refrigerant piping in accordance with ASHRAE 15 "Safety Code for Mechanical Refrigeration".
4. Fittings: ISO 9001 certified manufacturer.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for refrigerant piping materials and products.

B. Brazing Certification: Certify brazing procedures, brazers and operators in accordance with ASME standards (ANSI B31.5).

C. Shop Drawings: Submit scaled layout drawings of refrigerant pipe and fittings including, but not necessarily limited to, pipe and tube sizes, locations, elevations, and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spatial relationship between piping and proximate equipment.

D. Record Drawings: At project closeout, submit record drawings of installed refrigerant piping and piping products, in accordance with requirements of Division 01.

E. Maintenance Data: Submit maintenance data and parts lists for refrigerant piping materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual; in accordance with requirements of Division 01.

1.4 WARRANTY

A. Fitting Manufacturer's Warranty: Manufacturer agrees to replace components that fail in materials or workmanship within specified warranty period.

1. Fittings Warranty Period: Ten years from date of delivery to purchaser.
2. Fitting Tool Warranty Period: Two years from date of purchase.

1.5 PRODUCT STORAGE

A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 MATERIALS AND PRODUCTS

A. General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide materials and products complying with ANSI B31.5 Code for Refrigeration Piping where applicable, base pressure rating on refrigerant piping system maximum design pressures. Provide sizes and types matching piping and equipment connections; provide fittings of materials that match pipe materials used in refrigerant piping systems. Where more than one type of materials or products are indicated, selection is Installer's option.

2.2 BASIC PIPES AND FITTINGS

A. Refrigeration Piping:

1. Copper Tube Size 4-1/8 in. and Smaller: ASTM B280, copper tube; Type ACR, hard-drawn temper; ANSI B16.22, wrought-copper, solder-joint fittings; brazed joints.
2. Copper Tube Size 3/4 in. and Smaller: ASTM B280, copper tube; Type ACR, soft annealed temper; fittings, cast copper-alloy fittings for flared copper tubes; flared joints.
3. Copper Tube Size 7/8 in. through 4-1/8 in.: ASTM B280, copper tube; Type ACR, soft annealed temper; ANSI B16.22, wrought-copper, solder-joint fittings; brazed joints.

B. Brazed Joints: Braze joints using American Welding Society (AWS) classification BCuP-4 for brazing filler metal.

C. Copper Tube, Pressure-Seal-Joint Fittings for Refrigerant Piping:

1. Acceptable Product: Subject to compliance with requirements, provide Parker Hannifin Corporation; ZoomLock MAX Flame-Free Refrigerant Fittings.
2. Fittings: UL 207 Listed.
3. Fitting Body: Refrigerant-grade copper in accordance with ASTM B75 or ASTM B743.
4. O-Rigns: HNBR or Neoprene for R22 refrigerant only.
5. Tools: Manufacturer's approved special tools.
6. Maximum Rated PRessure (MRP): 700 psig (48 bar).
7. Continuous Operating Temperature: 250 def F (121 deg. C).
8. O-Ring Temperature Rating: Minus 40 to 284 deg F (Minus 40 to 140 deg. C).

9. Minimum Burst Pressure in accordance with UL 207. 2100 psig (145 bar).
10. Vacuum Pressure Capability: 200 microns.
11. Complies with UL 109 for vibration resistance.
12. Approved for the following oils: POE, PVE, PAO, AB, and mineral oil.
13. Approved Tubing Materials: Copper-to-copper connections.
14. Compatible with the following copper tubing:
    a. Tubing tolerance must conform to ASTM B280, ASTM B88, or ASTM B743.
    b. 19 kN and 24 kN ZoomLock Max Jaws and compatible tools:
        1) Hard Drawn Copper, 1/4 to 1-1/8 inch (6.4 to 28.6 mm): Type ACR, M, L, K.
        2) Soft (Annealed) Copper 1/4 to 1-1/8 inch (6.4 to 28.6 mm): Type ACR, L, K.
    c. 32 kN ZoomLock Max Jaws and compatible tools:
        1) Hard Drawn Copper, 1/4 to 1-3/8 inch (6.4 to 35 mm): Type ACR, M, L, K.
        2) Soft (Annealed) Copper 1/4 to 1-3/8 inch (6.4 to 35 mm): Type ACR, L, K.
15. Standards Compliance:
    a. UL 207 Listed, approved for field and factory installations, SA#7511, SDTW(7).
    b. International Mechanical Code (IMC) 2021, 2018, 2015, 2012, 2009, 2006 per ICC-ES, PMG-1440.
    c. International Residential Code (IRC) and Uniform Mechanical Code (UMC) 2021, 2018, 2015, 2012, 2009, 2006 per ICC-ES, PMG-1440.
    d. ASHRAE 15, ANSI 15, ASME B31.5, ANSI 31.5, ASTM B75, ASTM B88, ASTM B743, ASTM B280, EN 12735-1.
    e. SAE Threaded Fittings: Conform to SAE J513 and SAE J533.
    f. Compatible ODM Fittings: Material conforms to C12200 copper in accordance with ASTM B280.

2.3 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:
1. Acceptable Product: Subject to compliance with requirements, provide Parker Hannifin Corporation; Diaphragm Packless Valves, or Approved Equal.
2. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
3. Diaphragm: Phosphor bronze and stainless steel with stainless steel spring.
4. Operator: Rising stem and hand wheel.
5. Seat: Nylon.
6. End Connections: Socket, union, or flanged.
7. Working Pressure Rating: 500 psig (3450 kPa).
8. Maximum Operating Temperature: 275 def F (135 deg. C).

B. Packed-Angle Valves:

1. Acceptable Product: Subject to compliance with requirements, provide Parker Hannifin Corporation; Packed-Angle Valves, or Approved Equal.
2. Body and Bonnet: Forged brass or cast bronze.
3. Packing: Molded stem, back seating, and replaceable under pressure.
4. Operator: Rising stem.
5. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
6. Seal Cap: Forged-brass or valox hex cap.
7. End Connections: Socketm union, threaded, or flanged.
8. Working Pressure Rating: 500 psig (3450 kPa).
9. Maximum Operating TemperatureL 275 deg. F (135 deg. C).

C. Check Valves:
1. Acceptable Products: Subject to compliance with requirements, provide Check Valves by one of the following:
    a. Parker Hannifin.
    b. Apollo Flow Controls, Conbraco Industries, Inc.
    c. Emerson Climate Technologies.
    d. Paul Mueller Company.
2. Body: Copper tubing per ASTM B280 latest.
3. Seat: Brass.
4. Stopper: Stainless steel ball.
5. Closing Spring (Optional): Stainless steel.
6. End Connections: Formed ODM/ODF copper sweat.
7. Maximum Opening Pressure: 1 psig (6.9 kPa) pressure differential.
8. Working Pressure Rating: 750 psig (5171 kPa).
9. Maximum Operating Temperature: 300 deg. F (149 deg. C).
10. UL Recognized in accordance with File SA5460, Volume 1, Section 9.

D. Service Valves:
1. Acceptable Products: Subject to compliance with requirements, provide Service Valces by one of the following:
    a. Parker Hannifin.
    b. Emerson Climate Technologies.
    c. Heldon Products, Henry Technologies.
    d. Paul Mueller Company.
2. Body: Brass with copper ODF sweat connection tubes.
3. Stem: Captivated desgn with elimination of traditional retaining ring; actuate with standard Allen wrench.
4. Working Operating Temperatures: Minus 40 to 250 deg. F (Minus 40 to 121 deg. C).

5. Maximum Working Pressure Rating: 500 psig (3450 kPa)
6. UL Recognized in accordance with File SA5188.

E. Refrigerant Locking Caps:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. C & D Valve, LLC.
   b. JB Industries.
   c. RectorSeal HVAC; a CSW Industries Company.
2. Description: Locking-type, tamper-resistant, tamper-resistant, threaded caps to protect refrigerant charging ports from unauthorized refrigerant access and leakage.
3. Material: Brass, with protective shroud or sleeve.
4. Refrigerant Identification: Color-coated, refrigerant specific design.
5. Specific Tool: For installing and unlocking.

F. Solenoid Valves: Comply with AHRI 760 and UL 429; listed and labeled by a National Recognized Testing Labortaory (NRTL).
1. Acceptable Basis-of-Design Products: Subject to compliance with requirements, provide Solenoid Valves by one the following:
   a. Parker Hannifin.
   b. Emerson Climate Technologies.
   c. Heldon Products, Henry Technologies.
   d. Paul Mueller Company.
2. Body and Bonnet: Plated steel or brass.
3. Solenoid Tube, Plunger, Closing Spring; Stanless steel.
4. Seat: Polytetrafluoroethylene.
5. End Connections: Threaded or socket.
6. Electrical: Molded, watertight coil with Junction Box, Conduit Boss, DIN, or Spade, and 24-V ac coil, or 12-V dc coil.
7. Working Pressure Rating/Maximum Rate Pressure: 650 psig (4482 kPa) or greater.
8. Maximum Operating (Fluid) Temperature: 240 deg. F (116 deg. C).
9. Minimum Operating (Fluid) Temperature: Minus 40 deg. F (Minus 40 deg. C).
10. Maximum Operating Pressure Differential: 400 psig (2760 kPa) or greater.
11. Maximum Ambient Temperature: 120 deg. F (49 deg. C).
12. Minimum Ambient Temperature: Minus 40 deg. F (Minus 40 deg. C).

G. Safety Relief Valves: Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
1. Acceptable Products: Subject to compliance with requirements, provide Sefety Relief Valves by one of the following:
   a. Parker Hannifin

b. Heldon Products, Henry Technologies.

c. Paul Mueller Company.

2. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
3. Piston, Closing Spring, and Seat Insert: Stainless steel.
4. Seat: Polytetrafluoroethylene.
5. End Connections: Threaded.
6. Working Pressure Rating: 400 psig (2760 kPa).
7. Maximum Operating Temperature: 240 deg. F (116 deg. C).

H. Thermostatic Expansion Valves: Comply with AHRI 750.

1. Acceptable Products: Subject to compliance with requirements, provide Thermostatic Expansion Valves by one of the following:
   a. Parker Hannifin.
   b. Emerson Climate Technologies.
   c. Paul Mueller Company.
2. Body, Bonnet, and Seal Cap: Forged brass or extruded brass or steel.
3. Diaphram, Piston, and Seat Insert: Stainless steel.
4. Closing Spring: Music wire.
5. Packing and Gaskets: Non-asbestos.
6. Capillary and Bulb: Copper or stainless steel tubing filled with refrigerant charge.
7. Suction Temperature: 40 deg. F (4.4 deg. C).
8. Superheat: Adjustable.
9. Reverse-flow option (for heat-pump applications).
10. End Connections: Socket, flare, or threaded union.
11. Working Pressure Rating: 700 psig (4820 kPa).

I. Moisture/Liquid Indicators:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Moisture and Liquid Indicators by one of the following:
   a. Parker Hannifin.
   b. Emerson Climate Technologies.
   c. Heldon Products, Henry Technologies.
2. Body: Plated steel.
3. Window: Clear, fused glass window with indicating element protected by filter screen.
4. Indicator: Color coded to show moisture content in parts per million (ppm).
5. Minimum Moisture Indicator Sensitivity: Indicate moisture above 30 ppm (varies based on refrigerant).
6. End Connections: Socket or flare.
7. Working Pressure Rating: 650 psig (4481 kPa).

8. Maximum Operating Temperature: 250 deg. F (121 deg. C).

J. Permanent Filter Driers: Comply with AHRI 730.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Permanent Filter Dryers by one of the following:
   a. Parker Hannifin.
   b. Emerson Climate Technologies.
   c. Heldon Products, Henry Technologies.
2. Body and Cover: Painted-steel shell.
3. Filter Media: 10 micron, pleated with integral end rings; stainless steel support.
4. Desiccant Media: Activated molecular sieve.
5. Designed for reverse flow (for heat-pump applications).
6. End Connections: Socket or Flare.
7. Access Ports: Optional NPS 1/4 (DN 8) 45-degree flare connections at entering and leaving sides for pressure differential measurement.
8. Maximum Pressure Loss: 2 psig (14 kPa).
9. Rated Flow: 30 tons (105 kW).
10. Working Pressure Rating: 650 psig (4482 kPa).
11. Maximum Operating Temperature: 250 deg. F (121 deg. C).

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Examine areas and conditions under which refrigerant piping systems materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF REFRIGERANT PIPING

A. Install refrigerant piping with 1/4 in. per ft. (1%) downward slope in direction of oil return to compressor. Provide oil traps and double risers where indicated, and where required to provide oil return.

B. Clean refrigerant piping by swabbing with dry lintless (linen) cloth, followed by refrigerant oil soaked swab. Remove excess oil by swabbing with cloth soaked in high flash point petroleum solvent, squeezed dry.

C. Bleed dry nitrogen through refrigerant piping during brazing operations.

D. All pipes shall be supported from the building structure in a neat a workmanlike manner, and wherever possible, parallel runs of horizontal piping shall be grouped together on trapeze type hangers. The use of wire or perforated metal to support pipes will not be permitted. Hanging pipes from other pipes will not be permitted. Spacing of pipe supports shall not exceed 6 ft. for pipes up to 1-1/4 in. and 10 feet on all other piping. Hanger shall pass around the insulation and an 18 gage steel protective band, 12 in. long, shall be inserted between the hangers and the insulation.

E. Insulation material shall be ½ in. thick for all pipe sizes less than 1 in. and 1 in. thick for all pipe sizes of 1 in and larger. Insulation shall be flexible closed cell foam equal to ArmaFlex by Armacell or approved equal. All refrigerant suction piping shall be insulated. Pipe insulation shall have a flame spread rating of not over 25, 50 smoke developed and 50 fuel contributed. Verify insulation requirements with code when installed in return air plenum spaces.

F. All pipe insulation shall be applied over clean, dry surfaces, butting adjoining sections firmly together. All fittings shall be insulated and finished in strict accordance with manufacturer's recommendations.

G. Insulation exposed to weather shall have waterproof and UV resistant covering equal to ArmaFlex Shield by Armacell.

H. Piping shown to be routed underground shall be contained within PVC piping sleeve.

I. Install refrigerant piping in accordance with ASHRAE 15.

J. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

K. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

L. Install piping adjacent to machines to allow service and maintenance.

M. Install piping free of sags and bends.

N. Install fittings for changes in direction and branch connections.

O. Select system components with pressure rating equal to or greater than system operating pressure.

P. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

Q. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels if valves or equipment requiring maintenance is concealed behind finished surface.

R. Slope refrigerant piping as follows:

    1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
    2. Install horizontal suction lines with a uniform slope downward to compressor.
    3. Install traps and double risers to entrain oil in vertical runs.
    4. Liquid lines may be installed level.

S. When brazing or soldering, remove solenoid-value coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

T. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

U. Install escutcheons for piping penetrations of walls, ceilings, and floors.

V. All piping installations shall be in compliance with all requirements of international mechanical code, Chapter II, as applicable to the refrigerant(s) provided for the project. Confirm all requirements (for piping sleeves, ventilated shafts, piping protection, and refrigerant detection) prior to start of piping installation.

3.3 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.

D. Soldered Joints: Construct joints in accordance with ASTM B 828 or CDA's "Copper Tube Handbook."

E. Brazed Joints: Construct joints in accordance with AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
2. Use Type BAg (cadmium-free silver) alloy for joining copper with broze or steel.
3. Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.
4. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Installation gasket concentrically positioned. Use suitable lubrications on bolt threads.

G. Copper Pressure-Seal Fittings: Join copper tubing and fittings with tools and installation procedure defined by fitting manufacturer.

1. Training: Installation by manufacturer-trained installers.
2. Installation:
    a. Install fittings following installation steps in accordance with manufacturer's written installation instructions.
    b. Examination: Upon delivery to the Project site, examine copper tubing and fittings for debris, defects, incise marks (manufacturer's engraving on tube), holes, and cracks.
    c. If any brazing is required, follow manufacturer's brazing guidelines. Not following guidelines will damage the internal O-ring, likely resulting in leaks.
    d. Do not crimp fittings over flared style tubing (ODF). The flare can be cut off and the fitting crimped to the tube if there is a minimum of 2 inches (51 mm) of tube remaining.
3. Installation general locations:
    a. Follow manufacturer's requirements on spacing and fitting location.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with Section 23 05 29 - MECHANICAL SUPPORTS AND ANCHORS for hangers, supports, and anchor devices.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 ft. (6 m) long.
2. Roller hangers and spring hangers for individual horizontal runs 20 ft. (6 m) or longer.
3. Pipe Roller: MSS SP-58, Type 44 for for multiple horizontal piping 20 ft. (6 m) or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Support horizontal piping within 12 inches (300) of each fitting.

E. Support vertical runs of copper tubing to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

F. Pipe identification: Refrigerant pipe located in areas other than the room or space where the refrigerating *equipment* is located shall be identified. The pipe identification shall be located at intervals not exceeding 20 feet (6096 mm) on the refrigerant piping or pipe insulation. The minimum height of lettering of the identification lavel shall be 1/2 inch (12.7 mm). The identificaiton shall indicate the refrigerant designation and safety group classification of refrigerant used in the piping system. For Group A2L and B2L refrigerants, the identification shall also include the following statement: "WARNING - Risk of Fire. Flammable Refrigerant". For Group A2, A3, B2 and B3 refrigerants, the identification shall also include the following statement: "DANGER - Risk of Fire or Explosion. Flammable Refrigerant". For any Group B refrigerant, the identification shall also include the following statement: "DANGER - Toxic Refrigerant".

3.5 INSTALLATION OF REFRIGERANT ACCESSORIES

A. Refrigerant Strainers: Install in refrigerant lines as indicated, and in accessible location for service.

B. Moisture-Liquid Indicators: Install as indicated on refrigerant liquid lines, in accessible location.

C. Refrigerant Filter-Dryers: Install in refrigerant lines as indicated, and in accessible location for service.

D. Evaporator Pressure Regulators: Install in refrigerant suction lines or evaporator outlets as indicated. Adjust, if required, for proper evaporator pressure.

E. Refrigerant Discharge Line Mufflers: Install as indicated, in horizontal or down flow portion of hot-gas lines, immediately after leaving compressor; not in riser.

3.6 EQUIPMENT CONNECTIONS

A. General: Connect refrigerant piping to mechanical equipment as indicated, and comply with equipment manufacturer's instructions where not otherwise indicated.

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.
    a. Fill system with nitrogen to the required test pressure.
    b. System to maintain test pressure at the manifold gauge throughout duration of test.
    c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
    d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

B. Prepare test and inspection reports and submit to the project Architect and Engineer.

C. Fittings: Perform the following inspections in accordance with manufacturer's written installation instructions:

1. Test copper tubing system for joint tightness in accordance with installation instructions.
2. Perform system leak checks in accordance with HVAC/R system manufacturer's instructions.

3.8 DEHYDRATION AND CHARGING SYSTEM

A. Install core in filter dryer after leak test but before evacuation.

B. Evacuate refrigerant system with vacuum pump; until temperature of 35°F (2°C) is indicated on vacuum dehydration indicator.

C. During evacuation, apply heat to pockets, elbows, and low spots in piping.

D. Maintain vacuum on system for minimum of 5 hours after closing valve between vacuum pump and system.

E. Break vacuum with refrigerant gas; allow pressure to build up to 2 psi.

F. Complete charging of system, using new filter dryer core in charging line. Provide full operating charge.

3.9 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, in accordance with manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION

SECTION 23 31 13.19

DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of ductwork accessories work is indicated on drawings and in schedules, and by requirements of this section.

B. Types of ductwork accessories required for project include the following:

1. Dampers.
    a. Low-pressure manual dampers.
    b. Control dampers.
2. Turning vanes.
3. Duct hardware.
4. Duct access doors.
5. Flexible connections.
6. Concealed Damper Regulators.

C. Refer to other Division 23 sections for testing, adjusting, and balancing of ductwork accessories; not work of this section.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of ductwork accessories, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Codes and Standards:

1. SMACNA Compliance: Comply with applicable portions of SMACNA “HVAC Duct Construction Standards, Metal and Flexible,” 2005 edition.
2. Industry Standards: Comply with latest ASHRAE recommendations pertaining to construction of ductwork accessories, except as otherwise indicated.
3. UL Compliance: Construct, test, and label fire dampers in accordance with UL Standard 555 “Fire Dampers and Ceiling Dampers.”
4. NFPA Compliance: Comply with applicable provisions of NFPA 90A latest edition “Installation of Air Conditioning and Ventilating Systems”, pertaining to installation of ductwork accessories.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for each type of ductwork accessory, including dimensions, capacities, and materials of construction; and installation instructions.

B. Shop Drawings: Submit manufacturer’s assembly type Shop Drawings for each type of ductwork accessory showing interfacing requirements with ductwork, method of fastening or support, and methods of assembly of components.

C. Maintenance Data: Submit manufacturer's maintenance data including parts lists for each type of duct accessory. Include this data, product data, and Shop Drawings in maintenance manual; in accordance with requirements of Division 01.

PART 2 - PRODUCTS

2.1 DAMPERS

A. Low Pressure Manual Dampers: Provide dampers of single blade type or multi blade type, constructed in accordance with SMACNA "HVAC Duct Construction Standards."

B. Control Dampers: Provide dampers with parallel blades for 2-position control, or opposed blades for modulating control. Construct blades of 16-ga steel; provide heavy-duty molded self-lubricating nylon bearings, 1/2 in. diameter steel axles spaced on 9 in. centers. Construct frame of 2 in. x 1/2 in. x 1/8 in. steel channel for face areas 25 sq.ft. and under; 4 in. x 1-1/4 in. x 16-ga channel for face areas over 25 sq.ft. Provide galvanized steel finish with aluminum touch up.

C. Manufacturer: Subject to compliance with requirements, provide dampers of one of the following:

1. Air Balance, Inc.
2. Nailor
3. American Warming & Ventilating, Inc.
4. Louvers & Dampers, Inc.
5. Penn Ventilator Co.
6. Ruskin Mfg. Co.
7. Pottorff

D. Fire Damper (FD)

1. Fabricated Fire Dampers: Provide dampers constructed in accordance with SMACNA "Fire Damper and Heat Stop Guide".
2. Damper frames shall be constructed of minimum 16 gauge welded galvanized steel channel. Frames in excess of 36 in. height shall have corner braces or equivalent means of strengthening to ensure squareness and rigidity. Frames shall be constructed for flanged ductwork connection. "Slip In" (insertion) type dampers shall not be acceptable. Frames shall be sized to match the final dimensions of the ducts including allowance where applicable, for the duct lining materials. Coordinate required installation details with Mechanical Installer.
3. Fire Dampers: Provide Class B or C Fire dampers, of types and sizes indicated. Provide fusible link rated at 160 to 165°F (71 to 74°C) unless otherwise indicated or required for special exhaust systems. Provide damper with positive lock in closed position, and with the following additional features:
    a. Damper Blade Assembly: Multi blade type, completely out of airstream.
    b. Damper Blade Assembly: Curtain type, completely out of the airstream.
    c. Blade Material: Steel, match casing.
    d. Blade Material: Stainless Steel.

4. Measurements diagonally from upper to lower opposite corners of the installed damper assembly, including multiple section dampers shall not differ by more than 1/8 in. or 0.2%, whichever is the greater.
5. Manufacturer: Subject to compliance with requirements, provide fire and smoke dampers of one of the following:
    a. Air Balance, Inc.
    b. American Warming & Ventilating, Inc.
    c. Greenheck
    d. Louvers and Dampers, Inc.
    e. Nailor
    f. National Control Air
    g. Penn Ventilator Co.
    h. Pottorff

2.2 TURNING VANES

A. Fabricated Turning Vanes: Provide fabricated turning vanes and vane runners, constructed in accordance with SMACNA “HVAC Duct Construction Standards”.

B. Turning Vanes: Turning vanes shall be double wall turning vanes fabricated from the same material as the duct. Tab spacing shall be SMACNA standard. Rail systems with non-standard tab spacings shall not be accepted. All tabs shall be used, do not skip tabs. Mounting rails shall have friction insert tabs that align the vanes automatically. Vanes shall be subjected to tensile loading and be capable of supporting 250 lbs when fastened per the manufacturer’s instructions.

C. Acoustic Turning Vanes: Provide acoustic turning vanes constructed of air-foil shaped aluminum extrusions with perforated faces and fiberglass fill.

D. Manufacturer: Subject to compliance with requirements, provide turning vanes of one of the following:
    1. Aero Dyne Co.
    2. Anemostat Products Div.; Dynamics Corp. Of America
    3. Barber-Colman Co.
    4. Ductmate Industries, Inc.
    5. Duro Dyne Corp.
    6. Hart & Cooley Mfg. Co.
    7. Register & Grille Mfg. Co., Inc.

2.3 DUCT HARDWARE

A. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:
    1. Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.

2. Quadrant Locks: Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12 in. Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

B. Manufacturer: Subject to compliance with requirements, provide duct hardware of one of the following:

1. Ventfabrics, Inc.
2. Young Regulator Co.

2.4 DUCT ACCESS DOORS

A. General: Provide where indicated, duct access doors of size indicated.

B. Construction: Construct of same or greater gauge as ductwork served, provide insulated doors for insulated ductwork. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct. Provide one side hinged, other side with one handle-type latch for doors 12 in. high and smaller, 2 handle-type latches for larger doors.

C. As an option, clamping type access doors may be installed.

D. Manufacturer: Subject to compliance with requirements, provide duct access doors of one of the following:

1. Air Balance Inc.
2. Ductmate Industries, Inc.
3. Duro Dyne Corp.
4. Register & Grille Mfg. Co., Inc.
5. Ruskin Mfg. Co.
6. Ventfabrics, Inc.
7. Zurn Industries, Inc; Air Systems Div.

2.5 FLEXIBLE CONNECTIONS

A. General: Provide flexible duct connections wherever ductwork connects to vibrating equipment. Construct flexible connections of neoprene coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibrations of connected equipment.

B. Manufacturer: Subject to compliance with requirements, provide flexible connections of one of the following:

1. American/Elgen Co,; Energy Div.
2. Ductmate Industries
3. Duro Dyne Corp.
4. Flexaust (The) Co.
5. Ventfabrics, Inc.

2.6 CONCEALED DAMPER REGULATORS: FOR VOLUME DAMPERS LOCATED ABOVE GYP BOARD, PLASTER OR OTHER HARD CEILINGS:

A. Concealed damper regulators shall be designed to control volume dampers from the ceiling line. Regulators shall be imbedded so the entire unit is flush with the finished surface. The regulator cover plate shall cover the joint between the box and the ceiling. The cover shall be adjustable from 1/2 in. to 1-1/8 in. utilizing the manufacturer's spanner wrench. Coverplate to have zinc plated finish, suitable for painting. Concealed damper regulators to be Young Regulator Model 315.

B. Volume dampers for concealed damper regulators shall be Young Regulator Model 5020-B (round) or Model 820A-C (rectangular), designed and installed for operation by ceiling mounted regulators.

C. Where required, provide Young Regulator Model 927 Right Angle Miter Gears, or Model 1200 Right Angle Worm Gear Regulator, to allow control of a damper that has the damper shaft perpendicular to the shaft from the ceiling mounted damper regulator.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF DUCTWORK ACCESSORIES

A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

B. Install turning vanes in square or rectangular 90° elbows in supply, return and exhaust air systems, and elsewhere as indicated.

C. Install manual balancing dampers for branch ducts and individual runout ducts as close to the main duct as possible.

D. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.

E. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

3.3 FIELD QUALITY CONTROL

A. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leak proof performance.

3.4 ADJUSTING AND CLEANING

A. Adjusting: Adjust ductwork accessories for proper settings, install fusible links in fire dampers and adjust for proper action.

1. Label access doors in accordance with Division 23 Section “MECHANICAL IDENTIFICATION”.
2. Final positioning of manual dampers is specified in Division 23 Section “MECHANICAL TESTING, ADJUSTING AND BALANCING”.

B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer’s touch-up paint.

3.5 EXTRA STOCK

A. Furnish extra fusible links to Owner, one link for every 10 installed of each temperature range; obtain receipt.

END OF SECTION

SECTION 23 31 13

METAL DUCTWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of metal ductwork is indicated on drawings and in schedules, and by requirements of this section.

B. All duct dimensions shown on drawings are net inside clear dimensions.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of metal ductwork products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with metal ductwork systems similar to that required for project.

C. Codes and Standards:

1. SMACNA Standards: Comply with SMACNA's "HVAC Duct Construction Standards, Metal and Flexible", First Edition, 2005, for fabrication and installation of metal ductwork.

2. ASHRAE Standards: Comply with ASHRAE Handbook latest edition, HVAC Systems and Equipment volume, Chapter 16 "Duct Construction", for fabrication and installation of metal ductwork.

3. NFPA Compliance: Comply with latest editions of NFPA 90A "Installation of Air Conditioning and Ventilating Systems" and NFPA 90B" Installation of Warm Air Heating and Air Conditioning Systems".

D. Field Reference Manual: Have available for reference at project field office, copy of SMACNA "HVAC Duct Construction Standards, Metal and Flexible".

E. Flame/Smoke Ratings: Provide composite mechanical system (insulating material, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

F. All adhesives, sealants and sealant primers shall contain low VOC (Volatile Organic Compunds), as outlined in the South Coast Air Quality Management District (SCAQMD) Rule #1168. The design intent for this project is to obtain LEED Credit 4.1, which requires that all adhesives, sealants and sealant primers comply with the SCAQMD Rule #1168.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for metal ductwork materials and products.

B. Shop Drawings: Submit scaled layout drawings of metal ductwork and fittings including, but not limited to, duct sizes, locations, elevations, and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spatial relationship between ductwork and proximate equipment. Show modifications of indicated requirements, made to conform to local shop practice, and how those modifications ensure that free area, materials and rigidity are not reduced.

C. Record Drawings: At project closeout, submit record drawings of installed metal ductwork and ductwork products, in accordance with requirements of Division 01.

D. Maintenance Data: Submit maintenance data and parts lists for metal ductwork materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual; in accordance with requirements of Division 01.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protection: Protect shop fabricated and factory fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.

B. Storage: Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 DUCTWORK MATERIALS

A. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials that are free from visual imperfections including pitting, seam marks, roller marks, and stains and discolorations, and other imperfections, including those that would impair painting.

B. Sheet Metal: All interior ducts shall be constructed with G-60 or better galvanized steel (ASTM A 653/A 653M) LFQ, chem treat. Exterior ductwork or duct exposed to high humidity conditions (i.e. moisture laden exhausts not specified to be stainless steel) shall be G-90 or better galvanized steel LFQ, chem treat.

C. Stainless Steel Sheet: Where indicated, provide stainless steel complying with ASTM A167; Type 302, 304, or 316; with No. 4 finish where exposed to view in occupied spaces, No. 1 finish elsewhere. Protect finished surfaces with mill-applied adhesive protective paper, maintained through fabrication and installation.

D. Aluminum Sheet: Where indicated, provide aluminum sheet complying with ASTM B209, Alloy 3003, Temper H14.

2.2 MISCELLANEOUS DUCTWORK MATERIALS

A. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.

B. Fittings: Provide radius type fittings fabricated of multiple sections with maximum 15° change of direction per section. Unless specifically detailed otherwise, use 45° laterals and 45° elbows for branch takeoff connections. Where 90° branches are indicated, provide conical type tees.

C. Duct Liner:

1. Fibrous glass, complying with Thermal Insulation Manufacturer's Association (TIMA) AHC-101; of thickness indicated with a minimum installed R-Value equal to 6.0 (1-1/2 in. thick minimum), with black-coated, fire-resistant airstream face, with EPA-registered antimicrobial agent.
2. Flexible Unicellular
    a. Ductwork Liner: ASTM C534 Type 1, Thickness 1-1/2 : with a minimum R-value equal to R-6.0.
3. Manufacturers:
    a. Certainteed "Toughgard".
    b. Knauf Type "EM".
    c. Johns Mansville "Permacote Linacoustic".
    d. Owens-Corning "Aeroflex Plus".
    e. No Substitutions

D. Duct Liner Adhesive:

1. Comply with ASTM C 916 "Specifications for Adhesives for Duct Thermal Insulation." Application shall conform to Manufacturer's written recommendations for the apparent application.
2. Adhesives shall be non-inflammable after curing.
3. Manufacturers:
    a. Benjamin-Foster.
    b. Duro Dyne "FPG".
    c. Kinco 15-137.
    d. Miracle PF-91.
    e. Manufacturer of duct liner used for this project.

E. Duct Liner Fasteners:

1. Comply with SMACNA "Installation Standards for Rectangular Ducts using Flexible Liner", Articles S2.0 through S2.11.
2. Comply with lining details as shown in the referenced SMACNA Section, Figures 2-22 and 2-23.
3. Clinched-pin type fasteners shall be "Grip-Nail", or approved equal.
4. Projecting pins in Type 3 or Type 4 applications shall be clipped off close enough to the retaining disc to provide proper anchoring and to prevent injury to personnel.

F. Duct Sealant:

1. Duct sealer shall be flexible, water-based, adhesive sealant designed for use in all pressure duct systems. After curing, it shall be resistant to ultraviolet light and shall seal out water, air, and moisture. Sealer shall be UL listed and conform to ASTM E 84.
2. Comply with requirements of SMACNA Table 1-2.
3. Manufacturers:

a. Benjamin-Foster
b. Ductmate - PROseal.
c. Duro Dyne S2.
d. Hardcast.
e. United Sheet Metal.

G. Duct Cement:
1. Non-hardening, non-migrating mastic or liquid elastic sealant of type applicable for fabrication/installation detail as compounded and recommended by manufacturer specifically for cementing fitting components, or longitudinal seams in ductwork.
2. Comply with requirements of SMACNA Table 1-2.
3. Manufacturers:
a. Benjamin-Foster.
b. Duro Dyne S2.
c. Hardcast.
d. United Sheet Metal.

H. Ductwork Support Materials:
1. General:
a. Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.
b. Comply with applicable provisions of SMACNA 2005 Standards, Figures 4-1 through 4-8, and Tables 4-1 through 4-3.
2. Except where space is indicated as “High Humidity” area, interior support materials of not less than 1/4 in. diameter or 3/16 in. thickness may be plain (not galvanized).
3. For exposed stainless steel ductwork, provide matching stainless steel support materials. For copper ductwork, provide copper, bronze or brass support materials.
4. For aluminum ductwork, provide aluminum support materials except where materials are electrolytically separated from ductwork.

2.3 FLEXIBLE DUCTS

A. General:
1. Spiral wound spring steel with flameproof metallized polyester sheathing, complying with UL181.
2. Comply with applicable provisions of SMACNA 2005 Standards, pages 3-13 through 3-20.
3. Installation shall conform to conditions under which UL listing was granted.
4. Flexible Ductwork runouts shall be limited to 6' - 0" extended length.

B. Insulation:

1. Insulate all flexible ducts, both supply and return, with a minimum R-Value of 6.0, per International Energy Conservation Code – latest edition. Duct shall have a continuous flexible fiberglass sheath with UL approved metallized polyester barrier jacket.

C. Flexible Ductwork shall be equal to ATCO #036

D. Manufacturers: Subject to compliance with requirements, provide flexible ducts manufactured by one of the following:

1. ATCO.
2. Thermaflex.
3. Quietflex.

2.4 FABRICATION

A. Shop-fabricate ductwork in 4,8,10, or 12 ft. lengths, unless otherwise indicated or required to complete runs. Preassemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match mark sections for reassembly and coordinated installation.

B. All duct dimensions shown on drawings are net inside clear dimensions.

C. Shop-fabricate ductwork of gauges and reinforcement complying with SMACNA 2005 Standards as follows:

1. Rectangular, Steel:
   a. Tables 1-1 through 1-13.
   b. Figures 1-2 through 1-18.
   c. Fittings and Construction, Section II.
2. Rectangular, aluminum: Pages 1-31 through 1-33.
3. Round, Oval and Flexible Duct: Section III.

D. Shop fabricate ductwork of gauges and reinforcement complying with ASHRAE Handbook, HVAC Systems and Equipment Volume, Chapter 16 “Duct Construction”.

E. Longitudinal Seams: Pittsburgh lock shall be used on all longitudinal seams. All longitudinal seams will be sealed with mastic sealant. Snaplock is not acceptable.

F. Ductmate or W.D.C.I. proprietary duct connection systems will be acceptable. Duct constructed using these systems will refer to the manufacturers guidelines for sheet gauge, intermediate reinforcement size and spacing, and joint reinforcements.

G. Formed on flanges (T.D.C./T.D.F./T-25A/T-25B) will only be acceptable when submitted for approval prior to installation of any ductwork. Formed on flanges will be constructed as SMACNA T-25 flanges, whose limits are defined on Page 1.36 of the 2005 SMACNA Manual, First Edition. No other construction pertaining to form on flanges will be acceptable. Formed on flanges shall be acceptable for use on ductwork 42 in. wide or less, with 2 in. positive pressure static or less, and must include the use of corners, bolts and cleat.

H. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center line radius equal to associated duct width; and fabricate to include turning vanes in elbows where shorter radius is necessary. Limit angular tapers to 30° for contracting tapers and 20° for expanding tapers.

I. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division 23 Section “Ductwork Accessories” for accessory requirements.

J. Fabricate ductwork with duct liner in each section of duct where indicated. Laminate liner to internal surfaces of duct in accordance with instructions by manufacturers of lining and adhesive, and fasten with mechanical fasteners. Comply with previous paragraph 2.2.

K. Round Duct Joints:

1. 0 in. - 20 in. diameter, interior slip coupling beaded at center, fastened to duct with sealing compound applied continuously around joint before assembling and after fastening. Wrap joints with 3 in. wide duct tape.
2. 21 in. - 72 in. diameter, use 3 piece, gasketed, flanged joints consisting of 2 internal flanges (with integral mastic sealant) split to accommodate minor differences in duct diameter, and one external closure band designed to compress gasketing between internal flanges. Example: Ductmate Spiralmate or equal.

L. Pressure Classifications:

1. Static pressure ratings for ductwork systems shall be as noted on the drawings, and/or shall conform to requirements of 2005 SMACNA Standards, Table 1-1.
2. In no case shall the pressure rating of the duct be less than that indicated in Table 1-1 for the apparent duct velocity.
3. Gauges of metal and reinforcing methods shall conform to SMACNA requirements as follows:
    a. Rectangular Steel: Table 1-3 through 1-13.
    b. Rectangular Aluminum: Tables 1-14 through 1-16.
    c. Round, or Flat Oval, Steel: Table 3-2.
    d. Round Aluminum: Table 3-3.

2.5 FACTORY-FABRICATED DUCTWORK

A. At Contractor’s option, factory-fabricated ductwork sections, fittings, etc., may be substituted for shop-made items.

B. Factory-fabricated items shall comply in every respect with SMACNA requirements listed previously in this Section, or show proof from a recognized, approved independent laboratory, prior to bidding, that the proposed construction methods produce products that equal, or exceed, the SMACNA 2005 Standards.

C. Comply with applicable provisions of International Mechanical Code and local ammendments.

D. Manufacturers: Subject to compliance with requirements, provide factory-fabricated ductwork and/or fittings of one of the following:

1. Ductmate, Inc., Monongahela, PA.

2. Semco Mfg., Inc.
3. United Sheet Metal Div., United McGill, Inc.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Examine areas and conditions under which metal ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF METAL DUCTWORK

A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air tight (5% leakage for systems rated 3 in. and under; 1% for systems rated over 3 in.) and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8 in. misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type that will hold ducts true to shape and to prevent buckling. Support vertical ducts at every floor. Seal all longitudinal and transverse duct joints and seams with non-hardening duct mastic.

B. All round duct taps shall be conical type. All rectangular duct taps shall have 45° mitered entry per SMACNA.

C. Inserts: Install concrete inserts for support of ductwork in coordination with formwork, as required to avoid delays in work.

D. Field Fabrication: Complete fabrication of work at project as necessary to match shop fabricated work and accommodates installation requirements.

E. Routing: Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct useable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Where possible, locate insulated ductwork for 1 in. clearance outside of insulation. Limit clearance to 1/2 in. where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with structural members, suspended ceiling, lighting layouts, sprinkler piping, plumbing systems and similar finished work.

F. Electrical Equipment Spaces: Do not route ductwork through Electric Rooms, transformer vaults, and other electrical equipment spaces and enclosures.

G. Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gauge as duct. Overlap opening on 4 sides by at least 1-1/2 in. Fasten to duct and substrate.

1. Where ducts pass through fire rated floors, walls, or partitions, provide fire stopping between duct and substrate, in accordance with requirements of Division 07 Section “FIRE STOPPING”.

H. Coordination: Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.

I. Installation: Install metal ductwork in accordance with SMACNA HVAC Duct Construction Standards.

3.3 INSTALLATION OF DUCT LINER

A. General: Install duct liner in accordance with SMACNA HVAC Duct Construction Standards, pages 2-25 thru 2-29.

B. All supply and return ductwork serving rooftop units shall be lined with 1-1/2 in. thick acoustical lining for 20 feet from the unit.

3.4 INSTALLATION OF FLEXIBLE DUCTS

A. Maximum Length: For any duct run using flexible ductwork, do not exceed 6 ft. 0 in. extended length.

B. Installation: Install in accordance with Section III of SMACNA’s, HVAC Duct Construction Standards, Metal and Flexible”.

3.5 FIELD QUALITY CONTROL

A. Leakage Tests: After installation of each duct system that is constructed for duct classes over 3 in. is completed, test for duct leakage. Repair leaks and repeat tests until total leakage is less than 1% of system design airflow.

B. The testing shall be performed as follows:

1. Perform testing in accordance with HVAC Air Duct Leakage Test Manual.
2. Use a certified orifice tube for measuring the leakage.
3. Define section of system to be tested and blank off.
4. Determine the percentage of the system being tested.
5. Using that percentage, determine the allowable leakage (CFM) for that section being tested.
6. Pressurize to operating pressure and repair any significant or audible leaks.
7. Re-pressurize and measure leakage.
8. Repeat steps 6 and 7 until the leakage measured is less than the allowable defined in step 5.

3.6 EQUIPMENT CONNECTIONS

A. General: Connect metal ductwork to equipment as indicated; provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery. Provide access doors as indicated.

3.7 ADJUSTING AND CLEANING

A. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances that might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.

B. Strip protective paper from stainless ductwork surfaces, and repair finish wherever it has been damaged.

C. Temporary Closure: At ends of ducts that are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering that will prevent entrance of dust and debris until time connections are to be completed.

D. Balancing: Refer to Division 23 Section “TESTING, ADJUSTING AND BALANCING” for air distribution balancing of metal ductwork; not work of this section. Seal any leaks in ductwork that become apparent in balancing process.

END OF SECTION

SECTION 23 31 16.50
CORROSION-RESISTANT DUCTWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of corrosion-resistant ductwork is indicated on drawings and in schedules, and by requirements of this section.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of corrosion-resistant ductwork products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with corrosion-resistant ductwork systems similar to that required for project.

C. Codes and Standards:

1. NFPA Compliance: Comply with NFPA 90A "Installation of Air Conditioning and Ventilating Systems" latest edition, and NFPA 90B "Installation of Warm Air Heating and Air Conditioning Systems" latest edition.

2. ASHRAE Standards: Comply with 1996 ASHRAE Handbook, HVAC Systems and Equipment Volume, Chapter 16 "Duct Construction", for fabrication and installation of corrosion-resistant ductwork.

D. Field Reference Manual: Have available for reference at project field office, copy of corrosion-resistant duct manufacturer's installation instruction manual.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for corrosion-resistant ductwork materials and products.

B. Shop Drawings: Submit ductwork layout drawings in accordance with Division 01.

C. Record Drawings: At project closeout, submit record drawings of installed corrosion-resistant ductwork and ductwork products, in accordance with requirements of Division 01.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protection: Protect shop fabricated and factory fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.

B. Storage: Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 CORROSION-RESISTANT DUCTWORK

A. General

1. All corrosion-resistant ductwork is to be fabricated of Type 1, Grade 2, or Type 2, Grade 1, high impact PVC. Extruded Type 1 PVC duct 6 in. diameter to 18 in. diameter will be acceptable where applicable.
2. All duct systems are to be designed in accordance with the recommended practice of the American Conference of Governmental Industrial Hygienists (ACGIH), and fabricated in accordance with the Sheet Metal and Air Conditioning Contractors National Association (SMACNA) manual on Thermo-Plastic Construction.
3. All PVC used in the fabrication of ductwork shall be unplasticized, and shall conform to U.S. Commercial Standard CS 201-55, and ASTM 1784-69, Type II, Grade 1 LP-535b, Type II Grade GU. All PVC shall conform to ASTM Standard D 635, and shall have a flame spread rating no greater than 20.

B. Fittings: Round and Rectangular Ducts:
1. Flanges: Are to be made of PVC Type 1 or Type 2 angle material formed and continuously welded to the duct. Utilize 1-1/2 in. x 1-1/2 in. x 3/16 in. angle, or 2 in. x 2 in. x 1/4 in. angle, based on the specific duct sizes. Bolt holes to be minimum 5/16 in. at no more than 6 in. on center. Utilize stainless steel bolts for all connections. Gasket material is to be soft mastic type, or foam PVC, as is appropriate for the duct size and the fume service.
2. Sleeves: Shall be formed from three-inch (3 in.) wide flat PVC material of thickness equal to or greater than the wall thickness of the duct to be joined. Weld the sleeve to one end of a duct section, leaving one-half of the sleeve exposed for the adjoining section to slip onto.
3. Elbows: To have a minimum centerline radius of 1-1/2 times the diameter unless field conditions make it impossible. Ninety-degree elbows shall have five (5) gores and 45-degree elbows shall have three (3) gores.
4. Branches: To enter the mains at no more than forty-five degrees (thirty-degrees is preferred) to direction of flow, and wherever practical shall enter on an enlarging taper section. Do not install branches to enter the main opposite each other. Branches shall be continuously welded to the main.
5. Taper Section: 1 in. change in diameter to 5 in. in length, where practical.

C. Rectangular Duct Construction:
1. All straight lengths to have formed corner construction for maximum strength. This is to include taper section sections where practical. All elbows are to have welded corner construction.

D. Installation.
1. All joints are to be flanged or sleeved and made airtight. Sleeves may be welded or cemented. Flanged joints should be provided at all connections where dismantling may be required.
2. Ductwork shall be fitted with saddle bands at 8 ft. to 12 ft. on-center, and shall be suspended with all thread rods.
3. Ductwork shall be suspended on both sides of all changes in direction.

E. Welding: Welding shall be done by the hot air fusion welding method for PVC, and hot gas fusion welding method for poly-propylene. Ductwork, hoods and similar air passage enclosures must be finished completely air and watertight. Ductwork shall be completely free from cracks, distortion, or other imperfections.

2.2 FABRICATION

A. Shop-fabricate ductwork in 4, 8, 10 or 12 ft lengths, unless otherwise indicated or required to complete runs. Preassemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match mark sections for reassembly and coordinated installation.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Examine areas and conditions under which corrosion-resistant ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF CORROSION-RESISTANT DUCTWORK

A. Install corrosion resistant ductwork in strict accordance with manufacturer's instructions, including requirements for, fitting and joints, etc.

B. Provide temporary bracing and supports for larger ducts, per manufacturer's instructions and requirements. Remove all bracing and supports after installation is complete.

3.3 ADJUSTING AND CLEANING

A. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances that might cause corrosive deterioration, or where ductwork is to be painted, might interfere with painting or cause paint deterioration.

B. Temporary Closure: At ends of ducts that are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering that will prevent entrance of dust and debris until time connections are to be completed.

END OF SECTION

SECTION 23 36 13

AIR TERMINALS

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of air terminals work required by this section is indicated on Drawings and schedules, and by requirements of this section.

B. Types of air terminals specified in this section include the following:

1. Central Air Terminals:

a. Shutoff Single Duct

b. Reheat

c. Control Valves

C. Refer to other Division 23 sections for external insulation of air terminals; not work of this section.

D. Refer to other Division 23 sections for testing, adjusting and balancing of air terminals; not work of this section.

E. Refer to other Division 23 sections for temperature controls that are to be furnished by others but installed as work of this section.

F. Refer to other Division 23 sections for temperature controls for air terminals; not work of this section.

G. Refer to Division 26 sections for the following work; not work of this section.

1. Power supply wiring from power source to power connection on air terminals. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.

H. Provide the following electrical work as work of this section, complying with requirements of Division 26 sections:

1. Control wiring between field-installed controls and air terminals.

a. Control wiring specified as work of Division 23 for Automatic Temperature Controls is work of that section.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of air terminals with characteristics, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. ADC Compliance: Provide air terminals that have been tested and rated in accordance with ADC standards, and bear ADC Seal.

2. ARI Compliance: Provide air terminals that have been tested and rated in accordance with ARI 880 "Industry Standard for Air Terminals" and bear ARI certification seal.

3. NFPA Compliance: Construct air terminals using acoustical and thermal insulations complying with NFPA 90A " Installation of Air Conditioning and Ventilating Systems", latest edition.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including performance data for each size and type of air terminal furnished; schedule showing drawing designation, room location, number furnished, model number, size, and accessories furnished; and installation and start-up instructions.

B. Shop Drawings: Submit manufacturer's assembly-type shop Drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.

C. Wiring Diagrams: Submit ladder-type-wiring diagrams for electric power and control components, clearly indicating required field electrical connections.

D. Maintenance Data: Submit maintenance data and parts list for each type of air terminal; including "trouble-shooting" maintenance guide. Include this data, product data, shop Drawings, and maintenance data in maintenance manual; in accordance with requirements of Division 01.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver air terminals wrapped in factory-fabricated fiberboard type containers. Identify on outside of container type of air terminal and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in boxes.

B. Store air terminals in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide control valves of one of the following:

1. Phoenix Controls.
2. Antoc Controls.

B. Manufacturer: Subject to compliance with requirements, provide air terminals of one of the following:

1. ETI
2. Titus Products Div.: Philips Industries, Inc.
3. Trane Co.

2.2 AIR TERMINALS

A. General: Provide factory-fabricated and tested air terminals as indicated, selected with performance characteristics which match or exceed those indicated on schedule.

B. Casings: Construct of die-cast aluminum or sheet metal of the following minimum thickness:

	STEEL	ALUMINUM
Upstream Pressure Side:	24 gauge	0.032 in.
Downstream Pressure Side:	26 gauge	0.025 in.

1. Provide hanger brackets for attachment of supports.
2. Linings: Line inside surfaces of casings with lining material to provide acoustic performance, thermal insulation, and to prevent condensation on outside surfaces of casing. Secure lining to prevent delamination, sagging, or settling.
   a. Cover liner surfaces and edges with coating or perforated metal.
3. Access: Provide removable panels in casings to permit access to air dampers and other parts requiring service, adjustment, or maintenance.
   a. Provide airtight gasket and quarter-turn latches.
4. Leakage: Construct casings such that when subjected to 0.5-in wg. pressure for low-pressure units, and 3.0-in wg. pressure for high pressure units, total leakage does not exceed 4% of specified air flow capacity with outlets sealed and inlets wide open. Construct air dampers such that when subjected to 6.0-in wg. inlet pressure with damper closed, total leakage does not exceed 10% of specified airflow capacity.
5. Multiple Duct Connectors: For air terminals serving more than one air outlet, provide lined outlet plenum with duct collar, butterfly-type damper, and locking device in each outlet.

B. Air Valves: Provide spring-actuated venturi-type valves, construct of materials that cannot corrode, do not require lubrication, nor require periodic servicing. Provide valves and actuators that are calibrated in CFM, factory-adjusted, and marked for specified air capacities. Provide mechanism to vary air volume thru damper for minimum to maximum, in response from signal from thermostat and/or pressure sensor. Air valves shall be capable of achieving steady-state position in response to changes in space or exhaust ductwork pressureization in 1 second or less.

C. Controls: Provide controls accurate to 1.5°F (0.8°C) and adjustable from 65°F (22°C) to 85°F (29°C).
   1. Provide electronic DDC controls, compatible with electronic temperature control system specified in other Division 23 sections.

D. Identification: Provide label on each unit indicating Unit Number, CFM range, CFM factory-setting, and calibration curve (if required).

E. Central Air Terminals: Provide the following features and accessories indicated on Drawings and schedule:
   1. Electric Heating Coils: Provide heating coils constructed of electric resistance elements in galvanized steel casing with control box and factory-wiring. Provide over-temperature protection and UL-listing as duct heater.

PART 3 - EXECUTION

2.1 INSPECTION

A. Examine areas and conditions under which air terminals are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

2.2 INSTALLATION OF AIR TERMINALS

A. General: Install air terminals as indicated, and in accordance with manufacturer's installation instructions.

B. Location: Install each unit level and accurately in position indicated in relation to other work; and maintain sufficient clearance for normal service and maintenance, but in no case less than that recommended by manufacturer.

C. Duct Connections: Connect ductwork to air terminals in accordance with Division 23 ductwork sections.

2.3 FIELD QUALITY CONTROL

A. Upon completion of installation and prior to initial operation, test and demonstrate that air terminals, and duct connections to air terminals, are leak tight.

B. Repair or replace air terminals and duct connections as required to eliminate leaks, and retest to demonstrate compliance.

2.4 CLEANING

A. Clean exposed factory-finished surfaces. Repair any marred or scratched surfaces with manufacturers touch-up paint.

END OF SECTION

SECTION 23 37 13

AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of air outlets and inlets work is indicated by Drawings and schedules, and by requirements of this section.

B. Types of air outlets and inlets required for project include the following:

1. Ceiling return air grilles.
2. Ceiling air diffusers.
3. Wall registers and grilles.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. ARI Compliance: Test and rate air outlets and inlets in accordance with ARI 650 "Standard for Air Outlets and Inlets".
2. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets", latest edition.
3. ADC Compliance: Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual".
4. ADC Seal: Provide air outlets and inlets bearing ADC Certified Rating Seal.
5. AMCA Compliance: Test and rate louvers in accordance with AMCA 500 "Test Method for Louvers, Dampers and Shutters".
6. AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.
7. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Installation of Air Conditioning and Ventilating Systems" latest edition.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:

1. Schedule of air outlets and inlets indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.
2. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.
3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses, throw and drop, and noise criteria ratings. Indicate selections on data.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver air outlets and inlets wrapped in factory-fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

B. Store air outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 CEILING AIR DIFFUSERS

A. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of aluminum, except aluminum only for shower areas and as required for complete installation.

B. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

C. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction Drawings and specifications for types of ceiling systems that will contain each type of ceiling air diffuser. All air devices installed in plaster, gyp board or other hard ceilings or walls shall be provided with a separate mounting frame.

D. Types: Provide ceiling diffusers of type, capacity, and with accessories and finishes as listed on the air device schedule.

E. Diffuser Finishes:

1. Finish shall be off-white baked enamel.
2. Color selection shall be from manufacturer's standard color chips, unless otherwise noted.

F. Manufacturer: Subject to compliance with requirements, provide diffusers of one of the following:

1. Metalaire,
2. Krueger,
3. Nailor,
4. Price,
5. Titus,
6. No Substitutions.

2.2 WALL REGISTERS AND GRILLES

A. General: Except as otherwise indicated, provide manufacturer's standard wall registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide wall registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

C. Wall Compatibility: Provide registers and grilles with border styles that are compatible with adjacent wall systems, and that are specifically manufactured to fit into wall construction with accurate fit and adequate support. Refer to general construction Drawings and specifications for types of wall construction that will contain each type of wall register and grille.

D. Types: Provide wall registers and grilles of type, capacity, and with accessories and finishes as listed on the air device schedule.

E. Register and Grille Finishes:

1. Finish shall be off-white baked enamel.
2. Color selection shall be from manufacturer's standard color chips, unless otherwise noted.

F. Manufacturer: Subject to compliance with requirements, provide registers and grilles of one of the following:

1. Metalaire,
2. Krueger,
3. Nailor,
4. Price,
5. Titus,
6. No Substitutions.

2.3 CEILING GRILLE

A. General: Except as otherwise indicated, provide manufacturer's standard grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide grilles that have, as minimum, noise criteria ratings for each size device as listed in manufacturer's current data.

C. Ceiling Compatibility: Provide grilles with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling construction with accurate fit and adequate support. Refer to general construction Drawings and specifications for types of ceiling construction that will contain each type of ceiling grille.

D. Types: Provide ceiling grilles of type and with accessories as listed on the air device schedule.

E. Grille Finishes:

1. Finish shall be off-white baked enamel.

2. Color selection shall be from manufacturer's standard color chips, unless otherwise noted.

F. Manufacturer: Subject to compliance with requirements, provide grilles of one of the following:

1. Metalaire,
2. Krueger,
3. Nailor,
4. Price,
5. Titus,
6. No Substitutions.

2.4 OPPOSED BLADE DAMPER

A. Provide opposed blade dampers for all air devices unless where otherwise indicated on the plans.

B. Square damper frames shall be heavy duty extruded aluminum and interlocked to prevent corner separation. The blades shall be heavy gauge extruded aluminum, webbed to prevent bowing in large sizes and tapered to ensure tight closure. Blades shall be assembled on 1 in. centers and pivot on nylon bushings to ensure jam-free operation. Square neck opposed blade dampers shall be Metalaire Model D7 or approved equal.

C. Radial opposed blade dampers shall provide full radial volume control and manufactured of corrosion resistant aluminum material. Radial dampers shall provide durable, jam-free operation for the life of the air handling system. Radial dampers shall have overlapping blade design that insures positive shut-off when required. Radial damper operator shall be accessible through an opening located in the diffuser center cone. Radial opposed blade damper shall be Metalaire Model D3 or approved equal.

D. Radial slide dampers are not acceptable.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to ensure that products serve intended functions.

B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.

C. Unless otherwise indicated, locate units in center of acoustical ceiling modules.

3.3 SPARE PARTS

A. Furnish to Owner, with receipt, 3 operating keys for each type of air outlet and inlet that require them.

END OF SECTION

SECTION 23 74 13
ROOFTOP HEATING AND COOLING UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes packaged rooftop heating and cooling units.

B. Related Sections:

1. Section 23 05 12 - MECHANICAL AND ELECTRICAL COORDINATION.
2. Section 22 10 00 - PLUMBING PIPING.
3. Section 23 31 13 - METAL DUCTWORK.
4. Section 23 09 93 - SEQUENCE OF OPERATION.
5. Section 23 05 93 - MECHANICAL TESTING, ADJUSTING AND BALANCING.

1.2 SUBMITTALS

A. General: Do not use submittals as a proposal for equipment that has not been pre-approved during the bid process.

1. Do not base bids on unapproved items!

B. Product Data: Submit manufacturer's technical product data, indicating full compliance with scheduled capacities and characteristics, including specific capacities at the scheduled entering air conditions, dimensions, weights, operating clearances and specific references to all specialties and accessories as scheduled or specified, including installation and start-up instructions.

1. Data that does not apply to this specific project shall be marked out, or suitably deleted.
2. Units shall be specifically identified, using the same nomenclature as shown on the plans.

C. Shop Drawings: Submit Shop Drawings detailing the following:

1. Electrical requirements for power supply.
2. Ladder-type wiring diagrams for interlock and control wiring. Wiring diagrams shall clearly delineate field and factory wiring requirements, as well as the incorporation of special features that only apply to this specific project.
3. Details of the mounting, securing and flashing of the roof curb to the roof structure, including coordinating requirements with the roof membrane system.

D. Operation and Maintenance Data: Include maintenance data and parts lists for each rooftop unit, including "trouble-shooting" and maintenance guide, servicing guide and preventative maintenance schedule and procedures in the Maintenance Manual required in accordance with requirements of Division 01.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in the manufacture of rooftop heating and cooling units, of the types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. Testing and Rating Standards: Comply with applicable provisions of the following standards in effect as of the date of the Contract documents:

a. ARI 210 "Standard for Unitary Air Conditioning Equipment".

b. ARI 360 "Standard for Commercial and Industrial Unitary Air-Conditioning Equipment."

c. ARI 270 "Standard for Sound Rating of Outdoor Unitary Equipment."

d. Equipment shall bear the appropriate Certified Rating Seal.

e. Refrigeration system construction shall comply with ASHRAE Standard 15 "Safety Code for Mechanical Refrigeration," latest edition.

f. Energy Efficiency Ratio (EER) of rooftop units shall be not less than that indicated in ASHRAE Standard 90.1. "Energy Conservation in New Building Design", latest edition.

2. Rooftop units shall be U/L-listed, and the unit shall bear the U/L label.

3. Rooftop units shall be designed, manufactured and tested in accordance with UL requirements.

1.4 DELIVERY, STORAGE AND HANDLING

A. Handle rooftop units and components carefully to prevent damage. Replace damaged rooftop units or components with new.

B. Store rooftop units and components in a clean, dry place, off the ground, and protect from weather, water, and physical damage.

C. Rig rooftop units to comply with the manufacturer's rigging and installation instructions for unloading such equipment, and moving them to the final location.

1.5 SCHEDULING AND SEQUENCING

A. Coordinate installation of roof-mounting curb with roof structure.

B. Coordinate roof opening locations and mechanical, electrical, gas and drain locations.

1.6 WARRANTY

A. Warranty on Entire Unit: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, any components which show inadequate and defective materials and/or workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting and maintaining units have been properly followed during the warranty period. Replacement shall include component replacement and shall include labor for removal and re-installation.

1. Warranty Period: 1 year from date of substantial completion.

2. Warranty Card shall plainly state the name of the project, the started and ending dates fo the warranty period, and the serial numbers of the included equipment.

1.7 SPECIAL WARRANTY

A. Warranty on Compressor and Heat Exchanger: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, compressors and heat exchanger which show inadequate and defective materials and/or workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting and maintaining units have been properly followed during the warranty period. Replacement is limited to component replacement only, and does not include labor for removal and re-installation.

1. Warranty Period: 5 years from date of substantial completion for the Compressor.
2. Warranty Period: 15 years from date of substantial completion for the Heat Exchanger.
3. Warranty Card shall plainly state the name of the project, the starting and ending dates of the warranty period, and the serial numbers of the included equipment.

1.8 MAINTENANCE

A. Extra Materials: Furnish to Owner, with receipt, the following spare parts for each rooftop unit:

1. One set of matched fan belts for each belt-driven fan.
2. One set of filters for each unit.

PART 2 - PRODUCTS

2.1 ROOFTOP UNITS LESS THAN 20 TONS

A. Manufacturers: Subject to compliance with requirements, provide rooftop units of one of the following:

1. Aaon
2. Trane (The) Co; Div of American Standard Inc.

B. General Description: Rooftop unit shall be factory-assembled, pre-piped, pre-wired, and factory-tested, designed for roof or slab installation and, consisting of compressors, condensers, evaporator coils, condenser and evaporator fans, refrigeration and temperature controls, filters, and dampers. Capacities and electrical characteristics are scheduled on the Drawings.

C. Casing manufacturer's standard casing construction, having corrosion protection coating, and exterior finish. Casings shall have removable panels or access doors for inspection and access to internal parts, a minimum of 1" thick thermal insulation, knockouts for electrical and piping connections, and an exterior condensate drain connection, and lifting lugs. Condenser sections shall have inlet screens and fan discharge guards. Dual drain connections shall be accessible external to the cabinet.

D. Provide each RTU with a factory-fabricated roof curb as specified elsewhere in this section.

E. Evaporator fans: forward-curved, centrifugal, belt-driven fans with adjustable sheaves; and permanently lubricated motor bearings.

F. Condenser fans: propeller-type, direct-driven fans with permanently lubricated bearings.

G. Coils:

1. General: Aluminum plate fin and seamless copper tube type, with galvanized steel casing. Coils shall be mounted in the coil casing with same end connections accessible for service. Coils shall be removable from the unit through the roof or through the piping enclosure. Coil section shall be completely insulated.
2. Refrigerant cooling coils: Have an equalizing type vertical distributor and shall be proof (450 psig) and leak (300 psig) tested with air pressure under water. Coils shall be cleaned, dehydrated, and sealed with a holding charge of nitrogen.
3. Continuous tube type, and proof (300 psig) and leak (200 psig) tested with air pressure under water.
4. Condenser coils shall be protected with expanded metal type hail guards.

H. Provide stainless steel insulated drain pan, located under cooling coil section extensive enough to catch condensate leaving the coil at highest catalogued face velocity. Provide at least one drain connection at low point in drain pan. Drain connections shall be located so as to provide and ensure positive condensate drainage – no standing water.

I. Compressors: Serviceable, semi-hermetic, or hermetic compressors with integral vibration isolators, and crankcase heaters which deenergize during compressor operation. Units shall also have:
1. Cylinder unloaders for capacity control, with minimum steps as scheduled.
2. Hot-gas bypass valve and piping on one compressor for variable air volume systems
3. Thermal expansion valves, filter dryers, sight glasses, compressor service valves, liquid line service valves; minimum of 2 refrigerant circuits for units having 2 or more compressors; and fan-cycling control for low ambient control to 35°F (2°C).

J. Safety Controls:
1. Low pressure cutout, manual reset
2. High pressure cutout, manual reset
3. Compressor motor overload protection, manual reset
4. Anti-recycling timing device
5. Adjustable low-ambient lockout
6. Oil pressure switch

K. Economizer control: Return and outside air dampers, outside air filter, fully modulating electric control system with enthalpy control, and adjustable mixed-air thermostat. System shall have 100 percent outside air capability. Provide automatic changeover through adjustable enthalpy control device.

L. Variable air volume control: Discharge air step controller, electric control system with enthalpy control, and 7-day programmable time clock.

M. Electric heat sections: Manufacturer's standard construction electric heat coils, factory-wire for single point wiring connection. Complete with over-current and over-heat protection devices.

N. Filters section: 2 in. thick fiberglass throwaway filters in filter rack, with maximum face velocity of 300 fpm.

O. Electrical: Units shall have a 115 VAC convenience outlet, separately fused, for unit service. Unit power connection shall be either through unit cabinet or within roof curb perimeter.

P. Provide programmable room thermostats as follows:

1. Units shall be microprocessor-based with the following components:

a. Time & Temperature

b. Temperature Setting

c. Deadband Capabilities

d. Setback Programs

e. Temperature Adjust Override

f. Program Prompting

g. Control Program

h. Battery Backup

i. Setback Override

j. Locking Cover

Q. Unit shall be connected to, and controlled by, the Building Controls System.

R. Accessories: Units shall include the following accessories as indicated or scheduled:

1. Remote Control Panel: Furnish panel for remote mounting containing control of heating, cooling, evaporator fan, and outdoor damper; and indicator lights for up to 6 unit functions, including dirty filter indicator.

2. Anti-recycling control to automatically prevent compressor restart for 5-minutes after shutdown.

3. Low ambient control head pressure control, designed to operate at temperatures down to 0°F (-18°C).

4. Remote Status Panel: Furnish panel for remote mounting, containing indicator lights for up to six unit functions, including dirty filter indicator.

5. Locking Cover: Locking-type metal thermostat cover with key lock. Cover equal to BEKO BTG series. Size as required for thermostat actually furnished.

S. The Contractor shall for each air handling system with 2000 CFM (nominal 5 Tons) or greater airflow, install UL listed ionization smoke detectors in the main supply air duct and main return air duct and/or where shown on the drawings. Smoke detectors furnished by Division 26. Refer to Section 23 05 12. Connect the detectors into the control circuit to stop the fan in the event of the presence of smoke. Connection to Fire Alarm System by Division 26

1. System airflow includes the total airflow of all units serving any single space and all units connected to the same return air plenum.

2.2 PREFABRICATED ROOF CURBS

A. General: Provide manufacturer’s standard shop fabricated units, modified if necessary to comply with requirements.

B. Fabricate structural framing for units of structural quality sheet steel (ASTM A 570, Grade 40), formed to profiles indicated or, if not indicated, to manufacturer's standard profiles for coordination with roofing, insulation and deck construction. Include 45° angle cant strips and deck flanges with offsets to accommodate roof insulation. Weld corners and seams to form watertight units.

1. Clean and paint units with manufacturer's standard rust inhibitive metal primer paint.
2. Fabricate units from zinc steel coated steel, ASTM A 446, Grade C, designation G90 hot dip coating, mill phosphatized. Clean and paint with rust inhibitive metal primer paint, of type recommended by manufacturer, 2.0 mils dry film thickness.

C. Reinforce continuous runs of over 3 ft. 0 in. length, by inserting welded stiffeners of heavy gauge with flanges as required to provide sufficient rigidity and strength to withstand maximum lateral forces in addition to superimposed vertical loads.

D. Sloping Roof Decks: For deck slopes of 1/4 in. per foot and more, fabricate support units to form level top edge.

E. Gauge and Height: Fabricate units of metal gauge and to height above roof surface as indicated.

1. Where gauge or heights are not indicated, fabricate units of 14-gauge metal, and nominal height of 14 in. above the top of the roof.

F. Provide treated wood nailer, not less than 1 5/8 in. thick and of width indicated, but not less than width of support wall assembly. Anchor nailer securely to top of metal frame unit.

G. Provide lumber pressure treated with water borne preservatives for "above ground" use, complying with AWPB LP-2.

H. Fabricate exterior support profile to receive insulation of thickness indicated or, if not indicated, of 1 in. thickness.

I. Insulate units inside structural support wall with rigid glass fiber insulation board of approximately 3 lb. density and 1-1/2 in. minimum thickness, except as otherwise indicated.

J. Provide support liners where shown, formed of 22 Ga. galvanized sheet metal, mill phosphatized, flanged at lower edges.

1. Extend support liners through deck construction to coordinate with ductwork below as indicated.
2. Use perforated metal for support liners, with approximately 1000, 3/32 in. diameter holes per sq. ft., to provide sound absorbing surfaces.
    a. Provide sound insulation insert for curbs so indicated. Construct of 1 in. thick rigid fiberglass panels secured in galvanized steel framework, with rounded edges to minimize airflow resistance.

K. Metal Duct Reinforcement: Where indicated as integral part of support units, provide channel shaped metal deck closure strips to reinforce opening through metal decking. Fabricate strips from 14 Ga. metal to match metal and finish of curb units, except as otherwise indicated.

L. Manufacturer: Subject to compliance with requirements, provide prefabricated roof curbs of one of the following:

1. Teco.

2. Pate Co.
3. S & L Manufacturing Co.
4. ThyCurb Div.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which rooftop units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION

A. General: Install rooftop units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

B. Support: Install and secure roof curb to roof structure, in accordance with National Roofing Contractors Association (NRCA) installation recommendations and shop Drawings. Install and secure rooftop units on curbs and coordinate roof penetrations and flashing.

C. Electrical Connections: Refer to Section 26 05 20 - WIRE CONNECTION AND DEVICES for final connections to equipment and installation of loose-shipped electrical components.

3.3 DEMONSTRATION

A. Start-Up Services: Provide the services of a factory- authorized service representative to start-up rooftop units, in accordance with manufacturer's written start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

B. Operating and Maintenance Training:

1. Provide services of manufacturer's service representative to instruct Owner's personnel in operation and maintenance of rooftop units. Training shall consist of a minimum of 8 hours, not necessarily consecutive, and shall include start-up and shutdown, servicing and preventative maintenance schedule and procedures, and troubleshooting procedures plus procedures for obtaining repair parts and technical assistance. Review operating and maintenance data contained in the Operating and Maintenance Manuals specified in Division One.
2. Schedule training with Owner; provide at least 7-day prior notice to the Engineer.
3. Provide a written report of training periods to Owner and Engineer.

3.4 PIPING CONNECTIONS

A. Refer to Sections 22 10 00 of these specifications for condensate drain piping.

END OF SECTION

SECTION 23 89 65
MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Manufacturer's Data: Submit manufacturer's data and installation instructions on motor controllers.

1.2 QUALITY ASSURANCE

A. Comply with applicable requirements of NEC as applicable to installation, and construction of motor controllers.

B. Comply with applicable requirements of NFPA 70E, "Electrical Safety Requirements for Employee Workplaces," latest edition.

C. Comply with applicable requirements of UL 486A and B, and UL 508, pertaining to installation of motor controllers. Provide controllers and components that are UL-listed and labeled.

D. Comply with applicable requirements of NEMA Standards ICS 2, "Industrial Control Devices, Controllers and Assemblies", and Pub. No. 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)", pertaining to motor controllers and enclosures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide motor controllers of one of the following (for each type and rating of motor controller):

1. Allen-Bradley Co.
2. Cerus Industrial.
3. Cutler Hammer Products, Eaton Corp.
4. General Electric Co.
5. Square D Co.
6. Danfoss-Graham.
7. Reliance.
8. Cutler-Hammer

B. Manufacturers: Subject to compliance with requirements, provide variable speed (frequency) drives of one of the following:

1. ABB.
2. Yaskawa.

2.2 MOTOR CONTROLLERS

A. Except as otherwise indicated, provide motor controllers and ancillary components which comply with manufacturer's standard materials, design and construction in accordance with published information, and as required for a complete installation.

B. Fractional HP Manual Controllers: Provide single-phase fractional HP manual motor controllers, of sizes and ratings required to operate the motors shown on the contract documents. Equip with manually operated quick-make, quick-break toggle mechanisms; and with one-piece melting alloy type thermal units. Controller to become inoperative when thermal unit is removed. Provide controllers with double break silver alloy contacts, visible from both sides of controller; green pilot lights, and switch capable of being padlocked OFF. Enclose controller unit in NEMA Type 1 general-purpose enclosure suitable for flush mounting; coat with manufacturer's standard color finish for indoor installation. Enclose controller unit in weatherproof general-purpose enclosure coated with manufacturer's standard color finish for outdoor installation and where device is exposed to moisture.

C. Magnetic Starter, Across-The-Line:

1. Motor starters shall be across-the-line magnetic type rated in accordance with NEMA Standards, sizes and horsepower ratings as required for the motor controlled. Starters shall be mounted in general-purpose enclosures unless otherwise indicated on plans.
2. Across-the-line magnetic starters through NEMA size seven shall be equipped with double break silver alloy contacts. Single break contacts shall be supplied on size eight starters. All contacts shall be replaceable without removing power wiring or removing starter from panel. The starter shall have straight-through wiring.
3. Coils shall be of molded construction through NEMA size seven. Coils on size eight starters shall be form wound, taped, varnished and baked. All coils shall be replaceable from the front without removing the starter from the panel.
4. Overload relays shall be the melting alloy type with a replaceable control circuit module. Thermal units shall be of one-piece construction and interchangeable. The starter shall be inoperative if the thermal unit is removed. Provide overload heaters to protect the motor to be controlled.
5. Provide one spare normally-open contact and one spare normally-closed contact in each NEMA size 0 through size 7 starters.
6. Magnetic starters with "Hand-Off-Auto" selector switch and Form C contact, as manufactured by Square D, or acceptable substitute, three-pole, three-phase of NEMA size applicable with three melting alloy overload relays and three-position H-O-A switch in cover of general purpose enclosure.
7. Provide starters of the proper NEMA size to control each motor. Do not provide starters smaller than NEMA size 0.
8. Provide starters with low voltage transformers.

D. Variable Speed (Frequency) Drives:

1. Each variable speed drive shall convert 3 phase, 60-hertz utility power to variable voltage and frequency, 3 phase, AC power for stepless motor control from 10% to 110% of base speed. The variable speed drive shall be a variable voltage or current source type with a six-step output utilizing power and semiconductors. The variable speed drive, together with all options and modifications, shall install within a standard NEMA I enclosure suitable for continuous operation at a maximum ambient temperature of 104°F. All high voltage components within the enclosure shall be isolated with steel covers. Circuits shall provide DV/DT and DI/DT protection for semi-conductors. Protective circuits shall cause instantaneous trip should any of the following faults occur:
    a. 110% of controller maximum sine wave current rating is exceeded.
    b. Output phase-to-phase short circuit condition.
    c. High input line voltage.
    d. Low input line voltage.
    e. Loss of input phase.
    f. External Fault: This protective circuit shall permit, by means of the terminal strip, wiring of remote normally closed safety contacts such as high static, fire stat, etc., to shut down the device.
2. The following adjustments shall be available to the controllers:
    a. Maximum frequency (55 to 60 Hz).
    b. Minimum frequency (6 to 35 Hz).
    c. Acceleration (2 to 20 seconds).
    d. Deceleration (2 to 20 seconds).
    e. Volts/Hertz ratio.
    f. Voltage offset or boost.
    g. Current limit (50% to 110% sine wave current rating).
3. The variable speed drive shall be furnished with door mounted operator controls consisting of auto/manual switch, start/stop (reset) switch and manual speed control. In automatic mode, the controller shall follow an external signal and respond to remote start/stop contact wired to terminal strip. While in the auto mode, the controller shall automatically restart after the power outage.
4. Input disconnect shall provide a positive disconnect between the controller and all phases of the incoming AC line. This disconnect shall be designed to mount inside the controller enclosure and include a mounting bracket and through-the-door interlocking handle with provisions for pad locking. The basic switch shall be magnet only molded case breaker.
5. Manual contactor bypass with fused disconnect switch to allow the motor to run across the line in the event of VFD shutdown. Includes drive output contactor, full voltage starter with input disconnect switch with motor overload protection. Bypass shall be separated from the VFD by a metal barrier.

6. Motor overload shall contain a thermal overload relay designed to protect one AC motor operated on variable speed drive output from extended overload operation.
7. The variable speed drive shall follow in manual mode a set point frequency from a speed potentiometer. In automatic mode, the variable speed drive shall receive and follow a DC voltage signal from the microprocessor controller for full range operation.
8. Provide plug-in tester to provide a quick means for monitoring the different signals within the variable speed drive for startup and troubleshooting.

PART 3 - EXECUTION

3.1 COORDINATION WITH DIVISION 26

A. Portions of the work will be provided under Division 26. Refer to Section 23 05 12 for coordination of the work with Division 26.

3.2 EXAMINATION

A. Examine areas and conditions under which motor controllers are to be installed, and notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.3 INSTALLATION OF MOTOR CONTROLLERS

A. Install motor controllers for each motor, in accordance with equipment manufacturer's written instructions and with recognized industry practices; complying with applicable requirements of NEC, UL and NEMA standards, to insure that products fulfill requirements.

B. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and B, and the National Electrical Code.

3.4 FIELD QUALITY CONTROL

A. Prior to energization of motor controller equipment, check with ground resistance tester, phase-to-phase and phase-to-ground insulation resistance levels to insure requirements are fulfilled.

B. Prior to energization, check circuitry for electrical continuity, and for short-circuits.

C. Ensure that direction of rotation of each motor fulfills requirements.

D. Ensure that motor overloads are properly sized and installed.

3.5 GROUNDING

A. Provide equipment-grounding connections for motor controller equipment as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding.

3.6 ADJUSTING AND CLEANING

A. Adjust operating mechanisms, where necessary, for free mechanical movement.

3.7 DEMONSTRATION

A. Upon completion of installation of motor controller equipment and electrical circuitry, energize controller circuitry and demonstrate functioning of equipment in accordance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and retest to demonstrate compliance.

END OF SECTION

SECTION 26 00 00
BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 WORK INCLUDED

A. General Requirements specifically applicable to Division 26.

B. The Contractor shall be responsible for:
   1. The work included consists of furnishing all materials, supplies, equipment and tools, and performing all labor and services necessary for installation of a completely functional power, lighting, and signaling systems. Complete systems in accordance with the intent of Contract Documents.
   2. Coordinating the details of facility equipment and construction for all Specification Divisions, which affect the work covered under this Division.
   3. Furnishing and installing all incidental items not actually shown or specified, but which are required by good practice to provide complete functional systems.
   4. Temporary power service and lighting for construction. Coordinating all shutdown dates and schedules with Owner's Representative and obtain all work-permits required by Owner.
   5. Commissioning of Electrical Systems: Refer to Section 019113 “Building Systems Commissioning” for Division 26 Electrical System commissioning requirements and Division 26 Contractor roles and responsibilities in the commissioning process.

C. Intent of Drawings:
   1. The Drawings are necessarily diagrammatic by their nature, and are not intended to show every connection in detail or every device or raceway in its exact location, unless specifically dimensioned. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the work in order to avoid interference between the various phases of work. The Contractor shall be responsible for the proper routing of raceway, subject to prior review by the Owner and Engineer. 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 work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
   2. The intent of the Drawings is to establish the type of systems and functions, but not to set forth each item essential to the functioning of the system. The drawings and specifications are cooperative, and work or materials called for in one and not mentioned in the other shall be provided. Review pertinent drawings and adjust the work to conditions shown. In case of doubt as to work intended, or where discrepancies occur between drawings, specifications, and actual conditions, immediately notify the Architect/Engineer and the Owner’s representative, and propose a resolution.

1.03 RELATED WORK

A. This Section shall be used in conjunction with the following other specifications and related Contract Documents to establish the total general requirements for the project electrical systems and equipment.
   1. Division 01 Sections included in the project specifications.
   2. The contract.

1.04 DESIGN CRITERIA

A. Equipment and devices to be installed outdoors or in enclosures where the temperatures are not controlled shall be capable of continuous operation under such conditions per manufacturer’s requirements.

B. Compliance by the Contractor with the provisions of this Specification does not relieve him of the responsibilities of furnishing equipment and materials of proper design, mechanically and electrically suited to meet operating guarantees at the specified service conditions.

C. Electrical components shall be UL listed and labeled.

1.05 REFERENCE CODES AND STANDARDS, REGULATORY REQUIREMENTS

A. Standards of the following organizations as well as those listed in Division 01, may be referenced in the specification. Unless noted otherwise, references are to standards or codes current at the time of bidding. Work, materials and equipment must comply with the latest rules and regulations of the following.

1. International Building Code
2. Texas Accessibility Standards (State mandated)
3. Americans with Disability Act (ADA)
4. Association of Edison Illuminating Companies (AEIC)
5. American National Standards Institute (ANSI)
6. Institute of Electrical and Electronics Engineers (IEEE)
7. Insulated Cable Engineers Association (ICEA)
8. National Electrical Code (NEC)
9. National Electrical Manufacturers Association (NEMA)
10. National Electrical Safety Code
11. National Fire Protection Association (NFPA)
12. NFPA 70
13. NFPA 101 Life Safety Code
14. Underwriters' Laboratories (UL)
15. FM Standards
16. International Energy Conservation Code
17. National Electrical Safety Code
18. Occupational Safety and Health Act (OSHA)
19. American Society for Testing and Materials (ASTM)
20. University of North Texas Design and Construction Guidelines
21. Applicable state and federal codes, ordinances and regulations

B. Discrepancies. The drawings and specifications are intended to comply with listed codes, ordinances, regulations and standards. Where discrepancies occur, immediately notify the Owner's representative in writing and ask for an interpretation. Should installed materials or workmanship fail to comply, the Contractor is responsible for correcting the improper installation. Additionally, where sizes, capacities, or other such features are required in excess of minimum code or standards requirements, provide those specified or shown.

C. Contractor shall obtain permits and arrange inspections required by codes applicable to this Section and shall submit written evidence to the Owner and Engineer that the required permits, inspections and code requirements have been secured.

1.06 SUBMITTALS

A. Submit the following in addition to and in accordance with the requirements of Division 01 for submittal requirement.

1. Include inspection and permit certificates and certificates of final inspection and acceptance from the authority having jurisdiction.
2. Manufacturer's standardized schematic diagrams and catalog cuts shall not be acceptable unless applicable portions of it are clearly indicated and non-applicable portions clearly deleted or crossed out.
3. All schematic, connection and/or interconnection diagrams shall be in accordance with the latest edition of NEMA.
4. Provide submittals as required by individual specification Section.

B. Provide the following with each submittal:
   1. Catalog cuts with manufacturer's name clearly indicated. Applicable portions shall be circled and non-applicable portions shall be crossed out.
   2. Line-by-line specification review by equipment manufacturer and contractor with any exceptions explicitly defined.

C. Equipment Layout Drawing: 1/4-inch scale minimum drawings indicating electrical equipment locations. Dimensions for housekeeping pads should be indicated on these drawings. Indicate routing of conduit 2 inches and over on these drawings.

D. Within the specified time window after award of contract, submit list of equipment and materials to be furnished.
   1. Itemize equipment and material by specification Section number; include manufacturer and identifying model or catalog numbers.
   2. Replace rejected items with an acceptable item within 2 weeks after notification of rejection.
   3. If a satisfactory replacement is not submitted within a two-week period, owner will notify contractor as to equipment manufacturer or type and make or material to be furnished. Provide designated items at no additional cost to owner.

E. As-Built Record Drawings: The Contractor shall maintain a master set of As-Built Record Drawings that show changes and any other deviations from the drawings. The markups must be made as the changes are done. At the conclusion of the job, these As-Built Record Drawings shall be transferred to AutoCad electronic files, in a format acceptable to the Owner, and shall be complete and delivered to the Owner's Representative prior to final acceptance.

1.07 SAFETY

A. The Contractor shall follow the safety procedures in addition to, and in accordance with, the requirements of Project Safety Manual (PSM).
   1. The Contractors shall be responsible for training all personnel under their employ in areas concerning safe work habits and construction safety. The Contractor shall continually inform personnel on hazards particular to this project and update the information as the project progresses.
   2. The Contractor shall secure all electrical rooms, to limit access, prior to energizing any switchgear and shall control access during the project after energization. The Contractor shall post and maintain warning and caution signage in areas where work is ongoing near energized equipment. The Contractor shall cover all energized live parts when work is not being done in the equipment. This includes lunch and breaks.
   3. The Contractor shall strictly enforce OSHA lock out/tag out procedures. Initial infractions shall result in a warning; a second infraction shall result in the removal of the workman and his foreman from the site. Continued infractions shall result in removal of the Contractor from the site.

1.08 SHORING AND EQUIPMENT SUPPORTS

A. The Contractor shall provide all permanent and temporary shoring, anchoring, and bracing required to make all parts absolutely stable and rigid; even when such shoring, anchoring, and bracing are not explicitly called for.

B. The Contractor shall adequately support all freestanding panels, switchgear, switchboard, enclosures, and other equipment. This shall include bolting to the floor or solid structural steel to prevent tipping. Install free-standing electrical equipment on 4" thick concrete housekeeping pads. Under no condition shall equipment be fastened to non-rigid building steel (i.e., removable platform steel gratings, handrails, etc.).

C. The Contractor shall provide racks and supports, independently mounted at structure, to support electrical equipment and systems supplied and installed under this contract. At no time shall the Contractor mount or suspend equipment from other disciplines' supports.

1.09 TEMPORARY POWER REQUIREMENTS

A. Provide power distribution system sufficient to accommodate construction operations requiring power, use of power tools, electrical heating, lighting, and start-up/testing of permanent electric-powered equipment prior to its permanent connection to electrical system. Provide proper overload protection. Ground fault circuit interrupters (GFCI) are to be used on all 120-volt, single-phase, 15 and 20 amp receptacle outlets where portable tools and equipment are used. Ground fault circuit interrupters shall be tested weekly by the Contractor.

B. Temporary power feeders shall originate from a distribution panel. The conductors shall be multi-conductor cord or cable per NEC for hard and extra-hard service multi-conductor cord.

C. Branch circuits shall originate in an approved receptacle or panelboard. The conductors shall be multi-conductor cord or cable per NEC for hard and extra-hard service multi-conductor cord. Each branch circuit shall have a separate equipment grounding conductor.

D. All receptacles shall be of the grounding type and electrically connected to the grounding conductor.

E. Provide temporary lighting by factory-assembled lighting strings or by manually-assembled units. All lamps for general lighting shall be protected from accidental contact or breakage. Protection shall be provided by installing the lights a minimum of 7 feet from the work surface or by lamp holders with guards. Branch circuits supplying temporary lighting shall not supply any other load. Provide sufficient temporary lighting to ensure proper workmanship by combined use of day lighting, general lighting, and portable plug-in task lighting. Comply with OSHA required foot-candle levels and submit plan for approval by the owner.

F. For temporary wiring, suitable fencing, barriers, or other effective means shall be provided to prevent access of anyone other than authorized and qualified personnel.

G. Temporary power cords shall be kept off the ground or floor. The Contractor shall provide temporary supports as required to keep temporary cords off the ground or floor.

1.10 SUBSTITUTION OF MATERIALS AND EQUIPMENT

A. Refer to Uniform General Conditions and Supplementary General Conditions for substitution of materials and equipment.

B. The intent of the Drawings and/or Specifications is neither to limit products to any particular manufacturer nor to discriminate against an "APPROVED EQUAL" product as produced by another manufacturer. Some proprietary products are mentioned to set a definite standard for acceptance and to serve as a reference in comparison with other products. When a manufacturer's name appears in these Specifications, it is not to be construed that the manufacturer is unconditionally acceptable as a provider of equipment for this project. The successful manufacturer or supplier shall meet all of the provisions of the appropriate specification(s).

C. The specified products have been used in preparing the Drawings and Specifications and thus establish minimum qualities with which substitutes must at least equal to be considered acceptable. The burden of proof of equality rests with the Contractor. The decision of the designer is final.

D. When requested by the Architect/Engineer, the Contractor shall provide a sample of the proposed substitute item. In some cases, samples of both the specified item and the proposed item shall be provided for comparison purposes.

E. Timeliness: The burden of timeliness in the complete cycle of submittal data, shop Drawings, and sample processing is on the Contractor. The Contractor shall allow a minimum of six (6) weeks time frame for review of each submission by the office of the design discipline involved after receipt of such submissions by that design discipline. The Contractor is responsible for allowing sufficient time in the construction schedule to cover the aforementioned cycles of data processing, including time for all resubmittal cycles on unacceptable materials, equipment, etc. covered by the data submitted. Construction delays and/or lack of timeliness in the above

regard are the responsibility of the Contractor and will not be considered in any request for scheduled construction time extensions and/or additional costs to the Owner.

F. All equipment installed on this project shall have local representation; local factory authorized service, and a local stock of repair parts.

G. Acceptance of materials and equipment will be based on manufacturer's published data and will be tentative subject to the submission of complete shop Drawings indicating compliance with the contract documents and that adequate and acceptable clearances for entry, servicing, and maintenance will exist. Acceptance of materials and equipment under this provision shall not be construed as authorizing any deviations from the Specifications, unless the attention of the Architect/Engineer has been directed in writing to the specific deviations. Data submitted shall not contain unrelated information unless all pertinent information is properly identified.

H. Certification: The Contractor shall carefully examine all data forwarded for approval and shall sign a certificate to the effect that the data has been carefully checked and found to be correct with respect to dimensions and available space and that the equipment complies with all requirements of the Specifications.

I. Physical Size of Equipment: Space is critical; therefore, equipment of larger sizes than shown, even though of specified manufacturer, will not be acceptable unless it can be demonstrated that ample space exists for proper installation, operation, and maintenance.

J. Should a substitution be accepted, and should the substitute material prove defective, or otherwise unsatisfactory for the service intended within the guarantee period, this material or equipment shall be replaced with the material or equipment specified at no additional cost to the Owner.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and Equipment: Labeled and/or listed as acceptable to the authority having jurisdiction as suitable for the use intended. Materials shall be of a standard industrial quality if no specifications or specific model numbers are given.

B. Where two or more units of the same class of material are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.

C. All materials shall be new and unused.

PART 3 EXECUT`ION

3.01 WORKMANSHIP

A. Install work in compliance with NEC latest edition.

B. Install material and equipment in accordance with manufacturers' instructions. Provide calibrated torque wrenches and screwdrivers and tighten all terminals, lugs, and bus joints using it.

C. Comply with startup procedures as defined by Construction Manager and Owner.

D. Arrange electrical work in a neat, well-organized manner. Do not block future connection points of electrical service. Install all electrical work parallel or perpendicular to building lines unless noted otherwise, properly supported with purpose-designed apparatus, in a neat manner.

E. Apply, install, connect, erect, use, clean, adjust, and condition materials and equipment as recommended by the manufacturers in their published literature.

F. Make opening through masonry and concrete by core drilling in acceptable locations. Restore openings to original condition to match remaining surrounding materials.

3.02 SERVICE CONTINUITY

A. Maintain continuity of electric service to entire facility. Phase construction work to accommodate Owner's occupancy requirements.

B. Arrange temporary outages for cutover work with the Owner. Keep the outages to a minimum number and minimum length of time.

C. All service outages shall be requested in writing a minimum of four weeks prior to the date. Owner reserves the right to postpone shutdowns up to 24 hours prior to the shutdown at no additional cost. Outage requests shall include a schedule of the work to be performed, identification of areas impacted, and the time requirements.

D. The Contractor shall obtain all appropriate Owner permits for working in equipment.

3.03 HAZARDOUS LOCATIONS

A. Equipment, wiring, devices, and other components located within hazardous areas to be of appropriate type per NFPA requirements.

B. Ground exposed non-current carrying parts of entire electrical system in hazardous areas, in accordance with NEC and as instructed by Owner.

3.04 SLEEVES AND SEALS

A. Provide sealing and/or fire stopping where electrical system passes through walls, ceilings, and floors. Seals shall be watertight and/or fire rated as applicable.

B. Where coring foundation walls, vault wall, etc.; provide sufficient space between penetrations to maintain the structural integrity of the wall. Provide rubber sleeve equal to Link-Seal near the interior surface of the wall. The same space shall have waterproofing installed on the exterior side of the rubber seal.

3.05 CONSTRUCTION REVIEW

A. The Engineer or Owner's representative will review and observe installation work to ensure compliance by the Contractor with requirements of the Contract Documents.

B. Review, observation, assistance, and actions by the Engineer or Owner's representative shall not be construed as undertaking supervisory control of the work or of methods and means employed by the Contractor. The review and observation activities shall not relieve the Contractor from the responsibilities of these Contract Documents.

C. The fact that the Engineer or Owner's representative do not make early discovery of faulty or omitted work shall not bar the Engineer or Owner's representative from subsequently rejecting this work and insisting that the Contractor make the necessary corrections.

D. Regardless of when discovery and rejection are made, and regardless of when the Contractor is ordered to correct such work, the Contractor shall have no claim against the Engineer or Owner's representative for an increase in the Contract price, or for any payment on account of increased cost, damage, or loss.

3.06 WARRANTY

A. Provide warranties in accordance with the requirements of Uniform General and Supplementary Conditions (UGC).

END OF SECTION

SECTION 26 05 00
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 WORK INCLUDED

A. Hinged cover enclosures and cabinets

B. Contactors

C. Control relays

D. Push buttons, and selector switches

E. Terminal blocks and accessories

F. Penetration sealing systems (fire stops)

G. Electrical/control portion of HVAC work covered by Division 23 pertaining basic electrical materials and methods shall follow the requirement set forth by this specification.

1.03 APPLICABLE CODES AND STANDARDS

A. NFPA 70, National Electrical Code (latest edition)

B. American National Standard C2, National Electrical Safety Code, (latest edition)

C. Applicable publications of NEMA, ANSI, IEEE, and ICEA

D. Underwriters Laboratories, Inc. Standards (UL)

E. Federal, city, state, and local codes and regulations having jurisdiction

F. OSHA requirements

G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)

H. NEMA WD 1 - General-Purpose Wiring Devices

I. UL 98 - Enclosed Switches

1.04 INTENT

A. This Section is not, and shall not be interpreted to be, a complete listing of all materials or equipment that is Contractor furnished and erected. It is intended to clarify and further define the Contractor scope of work, procurement, and responsibilities for those incidental materials that are not specified by other specifications, but important to a complete and operational system.

B. The Contractor shall furnish all equipment and materials, whether or not specified in other Sections of specification and on drawings, for installation and connection required to place equipment into satisfactory operating service. The Contractor shall review the Drawings and specifications for clarification of his responsibility in the handling and installation of equipment and material. Where applicable, and not in contradiction with the Drawings and specifications, the Contractor shall install and connect the equipment in accordance with the manufacturer's recommendations and instructions.

C. All materials and equipment shall be of types and manufacturer specified wherever practical. Should materials or equipment so specified be unattainable, the Contractor shall submit the description and manufacturer's literature, reason for substitution request, and shall secure the approval of the Engineer before substitution of other material or equipment is purchased. This Section establishes performance requirements and the quality of equipment acceptable for use and shall in no way be construed to limit procurement from other manufacturer.

1.05 SUBMITTALS

A. Provide submittals in addition and in accordance with Section 260000, Basic Electrical Requirements, and Division 01 for submittal requirement.

B. Submit manufacturer's literature and specification data sheets for each type of basic material, which is applicable to the project.

1.06 DELIVERY, STORAGE AND HANDLING

A. Provide factory-wrapped waterproof flexible barrier material for covering materials, where applicable, to protect against physical damage in transit. Damaged materials shall be removed from project site.

B. In their factory-furnished coverings, store materials in a clean, dry indoor space, which provides protection against the weather.

PART 2 PRODUCTS

2.01 ENCLOSURES AND CABINETS

A. Enclosures and cabinets for all Contractor furnished electrical equipment and devices shall be suitable for the location and environmental conditions and shall be of the NEMA type as shown in Table 1. Exceptions shall be as specifically designated on the Drawings.

Table 1
Enclosures

Location	Environment	Enclosure Type
Indoor Utility	Dry, subject to dust, falling dirt and dripping non-corrosive liquids	NEMA 12
Indoor	Clean, Dry	NEMA 1
Outdoor	Subject to windblown dust and rain, splashing water, and hose-directed water	NEMA 4
Indoor	Wet, subject to hose-directed water	NEMA 4
Outdoor	Subject to falling rain, sleet, and external ice formation	NEMA 3R
Indoor or Outdoor	Subject to corrosion, windblown dust and rain, splashing water and hose-directed water	NEMA 4X

B. Enclosures shall have the following properties:
   1. Hinged Cover Enclosures: NEMA 250.
      a. Type 1: Steel.
      b. Type 4: Steel with gasket door, rain tight.
      c. Type 4X: Stainless steel.
      d. Type 12: Steel with gasketed door, dust-tight.

C. Finish: Exterior, manufacturer's standard gray enamel finish; interior, white enamel finish.

D. Covers: Continuous hinge, held closed by flush latch operable by hasp and staple for padlock. Where required for NEMA ratings, gaskets shall be neoprene rubber.

E. Interior Panel for Mounting Terminal Blocks or Electrical Components: 14-gauge steel, white enamel finish.

F. Provide protective pocket inside front cover with schematic diagram, connection diagram, and layout drawing of control wiring and components within enclosure.

G. Forced Ventilation: Where indicated, provide 115V single-phase fan motor, filtered with air plenum, finger guard, and stainless steel grille. Washable aluminum filter, accessible for cleaning from outside the enclosure; 20,000-hour continuous operation without lubrication or service. Provide matching exhaust grille assembly. Mount fan in lower side corner, exhaust grille in opposite upper side corner.

2.02 CONTACTORS

A. Acceptable Manufacturers
   1. Siemens
   2. Eaton
   3. Square D Company

B. Contactors: NEMA ICS 2; electrically held or mechanically held as indicated on Drawings. Two-wire control for electrically held contactors and three-wire control for mechanically held contactors.

C. Enclosure: NEMA 1 unless indicated otherwise on Drawings.

D. Coil operating voltage; 110 volts, 60 Hz or as per drawings.

E. Size: NEMA ICS 2; size as shown or as required.

F. Contacts: Ampacity as indicated on Drawings; 600 Volts, 60 Hz. (minimum 30A).

G. Provide solderless pressure wire terminals on bus terminals suitable for mounting in panelboard as indicated on Drawings.

2.03 CONTROL RELAYS

A. Acceptable Manufacturers
   1. Square D Company
   2. Eaton
   3. Siemens

B. Provide magnetic control relays, NEMA Class A: A300 (300 volts, 10 amps continuous, 7,200 VA make, 720 VA break), industrial control type with field-convertible contacts, and meeting the requirements of NEMA ICS 2.

C. Where time delay relays are specified or required, unless otherwise noted, provide magnetic control relays with a solid-state timer attachment adjustable from 0.2 to 60 seconds (minimum) or with range as indicated. Provide with field convertible from ON delay to OFF delay and vice versa.

D. Where latching (mechanically held) relays or motor thermal detector relays are specified or required, provide magnetic control relays with mechanical latch attachment with unlatching coil and coil clearing contacts.

2.04 PUSH BUTTONS, AND SELECTOR SWITCHES

A. Acceptable Manufacturers
   1. Square D
   2. Eaton
   3. Siemens
   4. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in 260000 and Division 01 for substitution requirement.

B. For non-hazardous, indoor, dry locations, including control panels, and individual stations, provide heavy duty, NEMA 13, oil tight type pushbuttons, indicating lights, selector switches, and stations for these devices.

C. For non hazardous, outdoor, or normally wet locations, or where otherwise indicated, provide heavy duty corrosion resistant, NEMA 4, watertight type pushbuttons, indicating lights, or selector switches mounted in NEMA 4 watertight enclosures. Provide special gasketing required to make complete station watertight.

D. For hazardous locations, provide control station listed by UL for Class I, Divisions 01 and 02, Groups C and D; Class II, Division 01 and 02, Groups E, F, and G. Specific type shall be in accordance with area classification.

E. Provide devices meeting the requirements of NEMA ICS 2, and having individual, extra large nameplates indicating their specific function. Provide push-button stations with laminated plastic nameplates indicating the drive they control. Provide contacts with NEMA designation rating A600. Install provisions for locking pushbuttons and selector switches in the OFF position wherever lockout provisions are indicated. Nameplates shall be as specified in Section 260553.

F. Utilize selector switches having standard operating levers. All indicating lights shall be LED type, push-to-test type. Provide ON or START pushbuttons colored black. Provide OFF or STOP pushbuttons colored red.

2.05 TERMINAL BLOCKS AND ACCESSORIES

A. Signal And Control Terminals
   1. Acceptable Manufacturers
      a. Phoenix Contact
      b. Buchanan
      c. Weidmüller
      d. Entrelec
      e. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in 230000 and Division 01 for substitution requirement.
   2. Signal and Control Terminals: Modular construction type, DIN 46 277/3 channel mounted; screw clamp compression connectors, rated 300 volts. Minimum terminal width of 0.24-inch, capable of holding two No. 12 or two No. 14 AWG conductors in each connector. Terminal identification numbers shall be thermoset characters (black) on a white background. Provide 25 percent spare terminals.

B. Power Terminals
   1. Acceptable Manufacturers
      a. Buchanan
      b. Ilsco
      c. Square D Company
      d. Burndy
      e. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in 260000 and Division 01 for substitution requirement.
   2. Power Terminals: Unit construction type, closed-back type, with tubular pressure screw connectors, rated 600 volts, size as required. Provide 25 percent spare terminals.

2.06 PENETRATION SEALING SYSTEMS (FIRE STOPS)

A. Provide penetration sealing where conduit, etc. pass through rated walls, ceilings, and floors.

2.07 UL LISTING

A. All equipment and materials shall be new and conform to the requirements of this Section. All equipment and materials shall be UL listed, and shall bear their label whenever standards have been established and level service is regularly furnished. All equipment and materials shall be of the best grade of their respective kind for the purpose.

PART 3 EXECUTION

3.01 FABRICATION - CONTROL ENCLOSURES AND CABINETS

A. Shop assembles enclosures and cabinets housing terminal blocks or electrical components in accordance with NEMA ICS 6.

3.02 INSTALLATION - ENCLOSURES AND CABINETS

A. Install cabinets and enclosures plumb; anchor securely to wall and structural supports at each corner, minimum. Direct attachment to dry wall is not permitted.

B. Provide accessory feet for freestanding equipment enclosures.

C. Install trim plumb.

3.03 ERECTION OF EQUIPMENT

A. Manufacturer's Installation Instructions: Where furnished or called for by the manufacturer equipment manufacturer's installation instructions shall be considered a part of this specification and fully complied with. Where the Contractor damages the finishing coat of paint in existing or completed areas, he shall refinish with matching paint.

B. Mounting Heights: Individual safety switches and buttons and devices shall normally be installed at the following mounting heights, when not specified on the Drawings.
   1. Safety Switches: 6 feet 0 inches (to top).
   2. Pushbuttons: 4 feet 0 inches (to center).
   3. Control Panels: 6 feet 0 inches (to top).

C. Mounting: Equipment and control devices shall be supported independent of conduit connections. Panels or cabinets shall be mounted on metal frame supports independently of equipment. Control devices and metal enclosures shall be bolted or welded to steel channel or steel plate. All electrical equipment and devices not covered by the above, such as miscellaneous switches, thermostats, duct switches, temperature switches, floats, photoelectrical devices, and similar electrical devices shall be located and set as suitable for the application. Where control panels are provided as part of the equipment racks mounted on the floor, they shall be provided to support conduits and flexible connections to control panels.

3.04 COORDINATION

A. Exact location of all electrical equipment, devices and fixtures shall be determined in field by contractor and verified by Engineer's field representative prior to installation.

END OF SECTION

SECTION 26 05 12
ELECTRICAL TESTING AND LOAD BALANCING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 WORK INCLUDED

A. Perform test, balance, final adjustment, etc., and record data for electrical work as described herein.

1.03 SUBMITTALS

A. Submit data record forms for approval before conducting any tests or making final adjustments, torquing, balancing, etc.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01 TESTING

A. 600V Conductors:
   1. Megger test feeder conductors at 600 volts dc. Record value for each feeder conductor. Conductors which test below 50 megohms shall be replaced. Retest new conductors and record data.
   2. Perform continuity test on all feeder and branch circuit conductors.
   3. Torque all feeder and branch circuit connections and terminations to manufacturer's recommended values.

B. Grounding:
   1. Measure and record ground resistance from system neutral connection at service entrance to ground reference point using suitable ground testing equipment. Resistance shall not exceed 2 ohms or as noted/required by laboratory equipment manufacturer.
   2. Test continuity and bonding of cable trays, wireways, etc.
   3. Record data for each test.

C. Metering and Control Wiring:
   1. Test for proper connection before energization of equipment. System shall be completely tested to verify proper operation and multipliers.
   2. Include metering and generator system remote annunciation/control.

D. Panelboards:
   1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
   2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   3. Perform the following infrared scan tests and inspections and prepare reports:
      a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard and panelboard.
   4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

E. Other Cable, Switchgear, Transformers, etc.
   1. Refer to individual specification section for additional testing requirements.

3.02 DEVICE TRIP SETTINGS

A. Equipment manufacturer field service personnel shall adjust and set all devices in accordance with approved results of "System Coordination and Analysis".

3.03 BUS TORQUING

A. All bolted bus connections shall be made using a torque wrench.

B. Bus and lug connections in panelboards and switchboards shall be in accordance with manufacturer's specifications.

3.04 LOAD/VOLTAGE DATA

A. Record amperage of each phase and neutral in each panelboard and switchboard.

B. Record voltage line-to-neutral and line-to-line of all phases in each panelboard and switchboard. Record each reading.

C. Lighting only panelboards shall be arranged so that under full load all phases carry the same load as near as possible.

3.05 PHASE ROTATION

A. Connect phases of Switchboards A, B, C, to Bus No. 1, 2, 3 from left to right or top to bottom.

B. Connect phases of Panelboards, Disconnects, Controllers A, B, C to Bus 1, 2, 3 from left to right.

C. Verify existing phase rotation and make final connection to motor loads to provide proper rotations.

3.06 MECHANICAL ADJUSTMENT

A. Adjust all operating mechanisms of electrical equipment for free mechanical movement.

END OF SECTION

SECTION 26 05 18
ELECTRICAL CONNECTIONS TO EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 WORK INCLUDED

A. The extent of electrical connections to equipment is indicated on the drawings and in schedules, in other Divisions of the specifications, and by the requirements of this section, and is hereby defined to include (but not necessarily limited to) connections for providing electrical power to equipment.

B. The types of electrical connections specified in this section include, but are not necessarily limited to, the following:
   1. To lab equipment
   2. To motors
   3. To electric heaters
   4. To motor starters
   5. From motor starters to motors
   6. To HVAC control and other control devices
   7. Miscellaneous equipment

1.03 SUBMITTALS

A. Submit manufacturer's product data on materials to be used on project.

PART 2 PRODUCTS

2.01 MATERIALS AND COMPONENTS

A. For each electrical connection indicated, provide a complete assembly of materials, including but not necessarily limited to the following:
   1. Pressure connectors
   2. Terminals (lugs)
   3. Electrical insulating tape
   4. Heat shrinkable tubing
   5. Cable ties
   6. Solderless wire nuts
   7. Conductors

B. Furnish materials and components in compliance with equipment manufacturer's recommendations for the intended application.

PART 3 EXECUTION

3.01 INSTALLATION OF ELECTRICAL CONNECTIONS

A. Install electrical connections as indicated, in accordance with recognized industry practices to ensure that products serve the intended functions.

B. Connect electrical power supply conductors to equipment conductors in accordance with other sections of the specifications and in accordance with equipment manufacturer's written instructions and wiring diagrams. Wherever possible, match conductors of the electrical connection for proper interface between the electrical supply and the installed equipment.
   1. Cover splices with electrical insulation equivalent to, or of a higher rating, than insulation on the conductors being spliced.

2. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure a uniform and neat appearance where cables and wires are terminated.
3. Trim cables and wires to be as short as practicable and arrange routing to facilitate inspection, testing and maintenance.

C. Provide conduit for connections in accordance with other sections of the specifications.

D. Coordinate installation of electrical connections to the equipment with equipment installation work and as follows:
1. Make electrical connections to equipment furnished under other sections of the Contract Documents.
2. Furnish wiring, conduit, outlet boxes, disconnect switches, etc., as required for same throughout the project.
3. Check the General Construction, Fire Protection, Plumbing, Heating and Air Conditioning plans and specifications and determine the amount of required wiring for final connections.
4. Verify locations, horsepower, voltages, etc., of all such equipment as the work progresses.
5. Advise the Architect/Engineer immediately, for clarification, if an apparent conflict arises in control wiring, power wiring, etc.

E. Due to manufacturer's changes or substitutions, equipment furnished under the mechanical and other sections of the specifications may require different rough-in and power requirements than indicated on the plans. Secure detailed drawings from the Contractor furnishing the equipment, to determine actual rough-in locations, and conduit and conductor requirements to assure a proper and workmanlike installation.

F. Install motor controls, safety switches, etc. for all equipment on unistrut with two coats of paint to match surrounding area.

3.02 FINAL CONNECTIONS FROM MOTOR STARTERS TO MOTORS

A. Furnish and install conduit, wiring, disconnects, etc., as required to install final connections from motor starters to motors. Verify number and size of conductors and disconnecting means requirements. Partwinding, and wye-delta starting, as well as multi-speed motors may require multiple or six pole disconnects which shall be furnished and installed under this section of the Contract Documents.

3.03 FINAL CONNECTIONS FOR EQUIPMENT FURNISHED BY OWNER OR UNDER OTHER SECTIONS OF THE CONTRACT DOCUMENTS

A. HVAC AND MECHANICAL EQUIPMENT: It is the Contractor's responsibility to obtain the submittal data for HVAC and mechanical equipment, check the data, and provide required electrical, including conduit and conductors, circuit breakers, fuses, disconnects, etc., to accommodate changes or variations in the drawings and/or specifications.

B. FOOD SERVICE EQUIPMENT: Verify exact locations and dimensions of food service equipment with equipment plan furnished by Food Service Contractors or suppliers and make all necessary electrical connections. It is the Contractor's responsibility to obtain the submittal data for food service equipment, check the data, and provide required electrical, including conduit and conductors, circuit breakers, fuses, disconnects, etc., to accommodate changes or variations in the drawings and/or specifications.

C. CASEWORK: Furnish and install receptacles, boxes, conduit, wiring and flexible metallic conduit associated with electrical power. Provide rough-in for telephone/data, audio/visual, etc.

D. MODULAR FURNITURE: Provide base feeds served from floor where furniture is equipped with integral wiring system with wiring devices. Where outlets are not integral to modular furniture, coordinate exact locations prior to rough-in. Power poles are not to be used.

E. LAB EQUIPMENT: It is the Contractor's responsibility to review laboratory equipment drawings and cut sheets and to obtain the submittal data, check the data, and provide required electrical, including conduit and conductors, circuit breakers, etc., to accommodate changes or variations in the drawings and/or specifications.

F. OTHER EQUIPMENT AND SYSTEMS: It is the Contractor's responsibility to obtain the submittal data for other equipment and systems, check the data, and provide required electrical, including conduit and conductors, circuit breakers, fuses, disconnects, etc., to accommodate changes or variations in the drawings and/or specifications.

END OF SECTION

SECTION 26 05 19
CABLE, WIRE AND CONNECTORS, 600 VOLT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 WORK INCLUDED

A. Building wire.
   1. Power distribution circuitry.
   2. Control system circuitry.
   3. Lighting circuitry.
   4. Appliance and equipment circuitry.
   5. Motor-branch circuitry.
   6. Outdoors lighting and power.
   7. Other systems circuitry as designated.

B. Cable.

C. Wiring connections and terminations.

D. Electrical/control portion of HVAC work covered by Division 23 pertaining 600 volt cable, wire and connectors shall follow the requirement set forth by this specification.

1.03 REFERENCES

A. NEMA WC 3 - Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

B. NEMA WC 5 - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

C. ANSI/UL 83 - Thermoplastic-Insulated Wire and Cables

D. NFPA 70 - National Electrical Code, latest edition

E. NEFA - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

F. Where application of National Electrical Code, trade association standards or publications appears to be in conflict with the requirements of this Section, the Architect/Engineer shall be asked for an interpretation.

1.04 SUBMITTALS

A. Provide submittals in accordance with and in addition to Section 260000, Basic Electrical Requirements, and Division 01 for submittal requirement.

B. Submit manufacturer's literature and specification data sheets for each item of cable, wire and connectors.

C. Qualification of cable and wire manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years experience.

1.05 DELIVERY, STORAGE AND HANDLING

A. Provide factory-wrapped waterproof flexible barrier material for covering wire and cable wood reels, where applicable; and weather resistant fiberboard containers for factory packaging of cable, wire and connectors, to protect against physical damage in transit. Damaged cable, wire or connectors shall be removed from project site.

B. Store cable, wire and connectors in a clean, dry indoor space in their factory-furnished coverings, which provides protection against the weather.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Generally, cable, wire and connectors shall be of manufacturer's standard materials, as indicated by published product information.

B. Provide factory-fabricated wire of the size, rating, material and type as indicated for each service. Where not indicated, provide proper selection as required to comply with installation requirements and with NEC standards. The minimum size wire to be used for power or lighting circuits shall be #12 copper with insulation as noted below. Minimum size for control shall be #14 copper.

C. If more than three phase conductors are installed in a single raceway, the conductors shall be derated in accordance with the National Electrical Code. Increase wire size so that resulting ampacity, after derating factor is applied, is equal to or greater than ampacity of conductor specified.

D. The conductors of wires and cables shall be of copper (tinned where specified), and have conductivity in accordance with the standardization rules of the IEEE. The conductor and each strand shall be round and free of kinks and defects.

E. Grounding conductors, where insulated, shall be colored solid green or identified with green color as required by the NEC. Conductors intended as a neutral shall be colored solid white, or identified as required by the NEC. All motor or equipment power wiring shall be colored according to Section 260553, Electrical Identification.

F. Use compression lugs for all wiring termination's, except on breakers or terminal strips in panel boards.

2.02 BUILDING WIRE

A. Thermoplastic-insulated Building Wire: NEMA WC 5.

B. Rubber-insulated Building Wire: NEMA WC 3.

C. Feeders and Branch Circuits Larger than 10 AWG: 98% conductivity copper, soft-drawn, stranded conductor, 600 volt insulation, THHN/THWN. Use XHHW conductors where installed in conduit underground.

D. Feeders and Branch Circuits 10 AWG and Smaller: 98% conductivity copper, soft-drawn, solid conductor, 600-volt insulation, THHN/THWN. Use XHHW conductors where installed in conduit underground.

2.03 REMOTE CONTROL AND SIGNAL CABLE

A. 600 Volt Insulation Control Cable for Class 1 Remote Control and Signal Circuits, Type TC:
   1. Individual Conductors: 14 AWG, stranded copper, XHHW insulation. Rated 90 degrees C dry, 75 degrees C wet, color-coded per ICEA Method 1 plus one green equipment grounding conductor.
   2. Assembly: Bundle wrapped with cable tape and covered with an overall PVC jacket. Cable shall pass IEEE-1202 vertical tray ribbon-burner flame test (210,000 BTU) VW-1.

B. Instrumentation Cable
   1. 300 Volt Instrumentation Cable, Multiple Pairs, Overall Shield, Type PLTC:
      a. Individual Conductors: 18 AWG, stranded, tinned copper, flame retardant polyethylene or PVC insulated, rated 105 degrees C, black and white numerically printed and coded pairs.
      b. Assembly: Individual twisted pairs having a 100 percent coverage aluminum-polyester shield and 20 AWG stranded tinned copper drain wire. Conductor bundle shall be shielded with 100 percent coverage overall aluminum-polyester shield complete with 20 AWG drain wire. All group shields completely isolated from each other. Bundle wrapped with cable tape and covered with an overall flame retardant

PVC jacket. Cable shall pass IEEE-383 vertical tray flame test (70,000 BTU) UL1581.

C. Plenum Cable for Class 3 Remote Control and Signal Circuits: 98% conductivity copper conductor, 300 volt insulation, rated 60 degree C, UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.

2.04 WIRING CONNECTIONS AND TERMINATIONS

A. Provide factory-fabricated, metal connectors of the size, rating, material, type and class as indicated for each service. Where not indicated, provide proper selection as required to comply with installation requirements and with NEC standards. Select from only following types, classes, kinds and styles.
   1. Type:
      a. Solderless pressure connectors.
      b. Crimp.
      c. Threaded.
      d. Insulated spring wire connectors with plastic caps for 10 AWG and smaller.
   2. Class:
      a. Insulated.
   3. Material:
      a. Copper (for CU to CU connection).
   4. Style: Pigtail connector.
      Parallel and tee connectors equal to ILSCO and GTA and GTT with ILSCO insulating cover. Parallel and tee connections shall be used only where specifically detailed. (Split bolt type connectors are not permitted.)

PART 3 EXECUTION

3.01 INSPECTION

A. Installer must examine the areas and conditions under which cable, wire and connectors are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Inspect wire and cable for physical damage. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 GENERAL WIRING METHODS

A. Install electrical cable, wire and connectors as indicated, in accordance with the manufacturer's written instructions, the applicable requirements of NEC and the National Electrical Contractors Association's "Standard of Installation", and as required to ensure that products serve the intended functions.

B. Coordinate cable and wire installation work with electrical raceway and equipment installation work, as necessary for proper interface. Do not install the conductors until raceway system is complete and properly cleaned.

C. Conductors shall be selected on the basis of their purpose and UL listing. Generally, use Types THWN and THHN in building interiors and other dry locations. Outdoors and under-ground in raceways, use Type XHHW.

D. No conductor smaller than No. 12 wire shall be used for lighting purposes. In the case of "home runs" over 50' in length, no conductor smaller than a No. 10 wire shall be used. Conductor sizes shown on drawings are minimum and shall be increased as necessary to comply with voltage drop restrictions specified herein. The sizing of all wire except remote control wire shall be accomplished in the case of both feeder and branch circuits by conforming to the following provisions.
   1. 120/208 Volt Branch Circuits: The voltage drop in the case of 120/208 volt circuits shall not exceed 2.0% at maximum load and 70.0% power factor.

2. 277/480 Volt Branch Circuits: The voltage drop in the case of 277/480 volt circuits shall not exceed 2.0% at maximum load and 70.0% power factor.

E. Separate neutral conductors shall be provided for each phase of the same size for 120V and 277V single-phase circuits. Do not share neutrals between circuits.

F. Remote control wires shall be no smaller than No. 14 conductors. Control wires shall be run in separate conduits. Departures from the sizes so determined shall be made only in those cases in which the National Electrical Code requires the use of larger conductors. The sizes as determined from these tables shall be regarded as the acceptable minimum under all other circumstances. In no case, however, shall there be a voltage drop greater than that specified in any feeder or branch circuit. The Contractor may, if he deems it necessary or advisable, use larger sized conductors than those shown. Under no circumstances, however, shall the Contractor use any conductors sized in a manner which does not conform to the above mentioned tables without having first secured the written approval of the Owner's duly authorized representative.

G. Exposed wire and cable is not permitted. All wire and cable shall be installed in conduit.

H. Splice branch circuits only in accessible junction or outlet boxes. Control cable shall never be spliced except the final connection to field devices. Where terminations of cables that are installed under this Section are to be made by others, provide pigtail of adequate length for neat, trained and bundles connections, minimum 5 feet at each location, unless noted otherwise on drawings.

I. Wiring within an Enclosure: Contractor shall bundle ac and dc wiring separately within an enclosure. The Contractor shall utilize panel wireways when they are provided. Where wireways are not provided the Contractor shall neatly tag, bundle wires and secure to sub-panel at a minimum of every three inches with T&B Type TC5355 heavy duty mounting bases.

J. Do not bend any conductor either permanently or temporarily during installation to radii less than four times the outer diameter of 600-volt insulated conductors.

3.03 WIRING INSTALLATION IN RACEWAYS

A. Wire and cable shall be pulled into clean dry conduit. Do not exceed manufacturer’s recommended values for maximum pulling tension and sidewall pressure.

B. Pull conductors together where more than one is being installed in a raceway.

C. Use UL listed pulling compound or lubricant, when necessary; compound must not deteriorate conductor and insulation.

D. Do not use a pulling means, including fish tape, cable or rope, which can damage the raceway.

E. 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.

F. Place an equal number of conductors for each phase of a circuit in same raceway.

G. Provide separate conduit or raceway for line and load conductors of motor starters, safety disconnect switches, and similar devices. Those devices shall not share the same raceway.

H. All conduits shall contain a green equipment grounding conductor. Provide isolated ground conductor to all isolated ground receptacles. Provide isolated ground conductor in 120/208 volt feeders as noted on drawings. Conduit, wireways, or boxes shall not be used as the equipment grounding conductor.

I. Provide separate conduit system for emergency power circuits. These circuits shall not share raceways with normal power or lighting circuits.

J. Conductors carrying more than 150 volts to ground shall not be installed in conduits with conductors carrying less than 150 volts to ground.

3.04 CABLE INSTALLATION

A. Provide protection for exposed cables where subject to damage during construction. Do not install cable before the completion of raceway system.

B. Cable shall be in conduit. Cables, conduits and raceways shall not be laid on ceiling tiles or strapped to ceiling wire.

C. Use suitable cable fittings and connectors.

D. It shall be the Contractor's responsibility to accurately measure all cable runs before the cable is cut. The Contractor shall furnish all tools and equipment, have sufficient properly trained personnel and shall exercise necessary care to ensure that the cable is not damaged during installation. Cable found to be damaged before installation shall not be installed. Cable damage during installation shall be removed and replaced. Repairs to cables can only be done with written permission from the Owner's Representative and only under special circumstances.

E. PVC jacketed cable shall not be installed or worked in any way at temperatures below 32 degrees F, unless cable has been previously stored in a heated area 48 hours prior to being pulled and transported to a heated pulling area.

F. Each cable entering an enclosure shall have its conductors bundled together and identified with the cable number. All groups of conductors within an enclosure shall be shaped and formed to provide a neat appearance to facilitate future additions or rework. All control conductors shall be numbered and shall be labeled at each termination with this number, using markers designed for the application.

G. Do not route power and control cables through communications rooms.

H. Fire alarm cable shall be installed in a separate conduit system.

I. Instrument Cable: Instrument cable shall be installed in conduit. They shall not be spliced at any point. The shields and drain wires of shielded signal cables shall be grounded only at one point.

3.05 WIRING CONNECTIONS AND TERMINATIONS

A. Install splices, taps and terminations, which have equivalent-or-better mechanical strength and insulation as the conductor. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

B. Keep conductor splices and taps accessible and to a minimum, and in junction boxes only. Control circuit conductors shall terminate at terminal blocks only. Do not splice below grade or in outdoor pull boxes.

C. Use splice, tap and termination connectors, which are compatible with the conductor material.

D. Thoroughly clean wires before installing lugs and connectors.

E. Terminate spare conductors with electrical tape and label as spare. Do not energize.

F. Power and Lighting Circuits: Use solderless pressure connectors with insulating covers for copper wire splices and taps, 8 AWG and larger. For 10 AWG and smaller, use insulated spring wire connectors with plastic caps on lighting and receptacle circuits.

G. Connections for all wire sizes in motor terminal boxes where the motor leads are furnished with crimped-on lugs shall be made by installing ring type compression terminals on the motor branch circuit ends and then bolting the proper pairs of lugs together. First one layer of No. 33 scotch tape reversed (sticky side out), then a layer of rubber tape, then two layers of No. 33 half-lapped.

H. Identify conductors per Section 260553 - Electrical Identification.

3.06 FIELD QUALITY CONTROL

A. Torque test conductor connections and terminations to manufacturer's recommended values.

B. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.

C. Conductors in vertical conduits or raceways shall be supported in the manner set forth in the appropriate section of the latest revision of the National Electrical Code.

D. Lighting fixtures shall not be used for raceways for circuits other than parallel wiring of fixtures.

E. Conductors may be run in parallel as shown on drawings, provided all paralleled conductors are the same size, length, and type of insulation. They shall be so arranged and terminated as to insure equal division of the total current between all conductors involved.

3.07 TESTING AND ACCEPTANCE

A. Before final acceptance, the Contractor shall make voltage, insulation, and load tests, necessary to demonstrate to the Owner's representative the satisfactory installation and proper performance of all circuits.

B. Test feeder conductors clear of faults. Insulation-resistance test shall be conducted per NETA – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems. Test results below 50 megohms shall be cause for rejection of the wiring installation. Replace and retest all such rejected conductor.

C. At the completion of this project, the Contractor shall provide for the Owner three (3) complete and finally corrected sets of working drawings. These sets of working drawings shall be new, unused and in good condition, and shall include the nature, destination, path, size and type of wire and all other characteristics for complete identification of each and every conduit and circuit.

END OF SECTION

SECTION 26 05 26
GROUNDING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 WORK INCLUDED

A. Power system grounding.

B. Communication system grounding.

C. Electrical equipment and raceway grounding and bonding.

1.03 REFERENCES

A. NFPA 70 - National Electrical Code, latest edition

B. ANSI/UL 467 - Electrical Grounding and Bonding Equipment

C. ANSI/IEEE STD 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems

D. IEEE 81 - Guide for Measuring Earth Receptivity, Ground Impedance and earth Surface Potential of a ground System

E. IEEE 1100 - Recommended Practice for Powering and Grounding Sensitive Electronic Equipment

F. ANSI/TIA/EIA 607 - Commercial Building Grounding and Bonding Requirements for Telecommunications

1.04 SYSTEM DESCRIPTION

A. Provide a completely grounded and bonded system in accordance with Article 250 of the NEC.

B. Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, boxes, cable sheath, ground bus in electrical rooms and IT rooms, metal frame of the building, ground rods, encased electrodes, grounding conductor in raceways and cables, receptacle ground connectors, lightning protection counterpoise, and metal underground water pipe.

C. Bonding jumpers shall be installed around non-metal fittings or insulating joints to ensure electrical continuity. Bonding shall be provided where necessary to ensure electrical continuity and the capacity to conduct safely any fault current likely to be imposed.

D. A special chemical ground system to serve both lab and sensitive test equipment shall be provided.

1.05 SUBMITTALS

A. Provide submittals in accordance with and in addition to Section 260000, Basic Electrical Requirements, and Division 01 for submittal requirement.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Grounding system components shall be as required to comply with the design and construction of the system indicated. Components shall be as indicated in manufacturer's submittal data.

B. Ground conductors shall be stranded tinned, annealed copper cable of the sizes indicated on drawings. Bond grounding conductors at both ends of metallic conduit.

C. Grounding clips shall be Steel City Type G, or equal.

D. Ground Rods shall be copper-encased steel, 3/4" diameter, minimum length 10 feet.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install ground system as indicated, in accordance with the applicable requirements of the National Electrical Code and the National Electrical Contractors Association's "Standard of Installation".

B. Install grounding conductors continuous, without splice or connection, between equipment and grounding electrodes. Install test wells as required per drawings.

C. In feeder and branch circuits, provide a separate, insulated equipment grounding conductor. Terminate each end on a grounding lug, bus, or bushing.

D. Connect grounding electrode conductors to metal water pipe where metal pipe is available and accessible using suitable ground clamp. Make connections to flanged piping at street side of flange. Provide bonding jumper around water meter.

E. Install fusion welded ground connectors where they are concealed or inaccessible.

F. Ground each outlet by the use of an approved grounding clip attached to the junction box in such a position to be readily inspected on removal of the cover plate; or by the use of an approved grounding yoke type receptacle.

G. No strap grounding clamps shall be used; connections requiring bolting shall be made up with monel metal bolts, washers and nuts. Connections shall be made only after surfaces have been cleaned, or ground to expose virgin metal.

H. Install external ground wire on liquid tight flexible metal conduit with grounding bushings.

I. Conductor connections shall be made by means of solderless connectors such as serrated bolted clamps or split bolt and nut type connectors.

J. 120 volt single phase circuits shall have a dedicated separate neutral. Do not share neutrals. Replace existing circuits that share a neutral so that all existing and new circuits do not share a neutral. Provide additional conduits as required.

K. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 3/0 AWG. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

L. Separately derived systems such as dry type transformers, etc. shall be grounded and bonded per NEC.

3.02 FIELD QUALITY CONTROL

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

B. Measure ground resistance from system neutral connection at service entrance to convenient ground reference point using suitable ground testing equipment. Resistance shall not exceed 2 ohms. Provide additional ground rod as required until resistance reading is 2 ohms or less.

END OF SECTION

SECTION 26 05 29
SECURING AND SUPPORTING METHODS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 WORK INCLUDED

A. Raceway and equipment supports.

B. Fastening hardware.

C. Coordinate location of concrete equipment pads.

1.03 QUALITY ASSURANCE

A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry. Support systems shall be sized adequately to support an additional 25% for future loads

1.04 COORDINATION

A. Coordinate with other trades where conduit supports are in the same location as piping, ductwork, and work of other trades and where supports are furnished and installed under other Divisions. Supporting from the work or supports of other Contractors shall not be allowed except by express, written permission of the Owner.

1.05 SUBMITTALS

A. Provide submittals in accordance with and in addition to Section 260000, Basic Electrical Requirements, and Division 01.

PART 2 PRODUCTS

2.01 MATERIAL

A. Support Channel: All non-corrosive locations: Hot-dip galvanized steel.

B. Hardware: All non-corrosive locations: Hot-dip galvanized steel.

C. Threaded Rod: Used for rack support from structure above; 1/4-inch minimum diameter.

2.02 CONDUIT ANCHORING

A. Conduit shall be securely anchored with split ring hangers, conduit straps, or other devices specifically designed for the purpose. Wire ties and spring clips are specifically not permitted. Do not support conduits from ceiling support wires.

PART 3 EXECUTION

3.01 INSTALLATION

A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using precast insert system, expansion anchors, or beam clamps. Do not use spring steel clips and clamps. Provide necessary calculations to select proper support materials for electrical equipment, raceway supports.

B. Install hangers, anchors, sleeves and seals as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to insure supporting devices comply with requirements. Comply with requirements of NEC for installation of supporting devices. Install supports with spacing in compliance with NEC requirements.

C. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors in solid masonry walls; or 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. Do not use powder actuated anchors without written permission from the Engineer.

F. Do not drill structural steel members without written permission from the Structural Engineer.

G. 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.

H. Bridge studs top and bottom with channels to support recessed mounted cabinets and panelboards in stud walls.

I. Install surface mounted cabinets and panelboards with a minimum of four anchors. Provide strut channel supports to stand cabinet 1-5/8 inches off wall. Utilize "Post Bases" where support channel is attached to structural floor.

J. Provide extra care in supporting PVC conduit to protect it from potential damage.

K. Use fiberglass for nonmetallic raceway systems supports in areas subject to corrosives.

L. All supports in contact with floor using stanchion type support shall be solidly bolted to the permanent structural floor.

M. Conduit supports shall have at a minimum, the bottom support member constructed of double strut. This horizontal member shall be double-nutted, and the supporting all-thread rod shall be trimmed to one inch below lowest nut.

N. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.

O. Install freestanding electrical equipment minimum on 4-inch concrete pads unless noted otherwise. Pad shall be a minimum four inches larger than equipment. No crevices shall be left around the pads. Equipment includes but not limited to the following:
   1. Floor mounted switchgear
   2. Dry type transformers

P. Do not anchor supports to columns. Where panelboards, cables, or conduits are routed on the face of a column provide “column hugging” channel supports.

3.02 TOUCH-UP

A. Touch-up all scratches on securing and supporting system and paint the ends of channel after cutting with an approved zinc chromate or 90 percent zinc paint.

END OF SECTION

SECTION 26 05 33
RACEWAYS, CONDUITS AND BOXES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 WORK INCLUDED

A. Raceways:
   1. Wireways.

B. Conduit:
   1. Rigid metal conduit and fittings (RGS).
   2. Intermediate metal conduit and fittings (IMC).
   3. Electrical metallic tubing and fittings (EMT).
   4. Flexible metal conduit and fittings.
   5. Liquid-tight flexible metal conduit and fittings.
   6. Non-metallic conduit and fittings (underground use only).

C. Boxes:
   1. Wall and ceiling outlet boxes.
   2. Pull and junction boxes.

D. Electrical/control portion of HVAC work covered by Division 23 pertaining raceway, conduit and boxes shall follow the requirement set forth by this specification.

1.03 REFERENCES

A. NFPA 70 - National Electrical Code, latest edition

B. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated

C. ANSI C80.3 - Electrical Metallic Tubing, Zinc-Coated

D. ANSI/NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies

E. EMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing

F. ANSI/NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports

G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)

H. ANSI/UL 1 - Flexible Metal Conduit

I. ANSI/UL 360 - Liquid-tight Flexible Steel Conduit

J. ANSI/UL 467 - Electrical Grounding and Bonding Equipment

K. ANSI/UL 651 - Schedule 40 and 80 Rigid PVC Conduit (underground use only)

L. ANSI/UL 797 - Electrical Metal Tubing

M. ANSI/UL 870 - Wireways, Auxiliary Gutters and Fittings

N. UL 6 - Rigid Metal Conduit

O. ANSI/UL 5C - Surface Raceways and Fittings for Use with Data, Signal, and Control Circuits

P. ANSI/UL 498 - Attachment Plugs and Receptacles

Q. ANSI/UL 943 - Ground Fault Circuit Interrupters

1.04 SUBMITTALS

A. Provide submittals in accordance with and in addition to Section 260000, Basic Electrical Requirements, and Division 01 for submittal requirements.

B. Shop drawings consisting of a complete list of equipment and materials, which will be used for the project, including manufacturer's descriptive and technical literature, catalog cuts and installation instructions.

C. Sealing/fire stopping materials and details.

D. Submit detailed shop drawing for Owner and Engineer approval showing all conduits 2” and larger. All conduits, regardless of size shall be concealed in finished areas of the building.

E. Submit cable pulling tension and sidewall pressure calculations for all service and feeder conduits.

1.05 STORAGE AND HANDLING

A. Handle materials carefully to avoid damage, breaking, denting and scoring. Damaged equipment or materials shall not be installed.

B. Store materials in a clean dry space and protected from the weather.

PART 2 PRODUCTS

2.01 WIREWAYS

A. Wireways shall be of steel construction general purpose for indoor spaces and rain tight for outdoor applications with knockouts.

B. Submit proposed site and location for approval. Use wireways only where acceptable to Owner and Engineer.

C. Cover shall be hinged or screw applied as indicated on Drawings. Rain tight wireways shall be provided with full gasketing.

D. Fittings shall be so constructed to continue the "lay-in" feature through the entire installation.

E. Provide all sheet metal parts with a rust inhibiting phophatizing primer coating and finished in gray enamel. All hardware shall be cadmium plated to prevent corrosion.

2.02 CONDUIT AND FITTINGS

A. Conduit and fittings for all electrical systems on this project shall include the following:
   1. Service entrance
   2. Electrical power and lighting feeders
   3. Electrical power and lighting circuits
   4. Control systems (other than HVAC)
   5. Division 28 systems
   6. Other electrical systems

B. For each electrical wireway system indicated, provide a complete assembly of conduit, tubing or duct with fittings including, but not necessarily limited to, connectors, nipples, couplings, locknuts, bushings, expansion fittings, other components and accessories as needed to form a complete system of the same type indicated.

C. Conduit fittings shall be designed and approved for the specific use intended. Conduit fittings, including flexible, shall have insulated throats or bushings. Rigid conduits shall have insulated bushings, unless grounding bushings are required by N.E.C. Article 250. Grounding bushings shall have insulated throats.

D. Rigid and intermediate metal conduit shall be hot-dipped galvanized. Fittings shall be threaded type. Expansion fittings shall be OZ Type DX.

E. Electrical metallic tubing shall be galvanized. Fittings shall be all steel compression water tight type. Expansion fittings shall be OZ Type TX.

F. Flexible metal conduit and fittings shall be zinc-coated steel.

G. Malleable metal fittings are not acceptable.

H. Liquid-tight flexible conduit and fittings shall consist of single strip, continuous, flexible interlocked, double-wrapped steel, galvanized inside and outside, forming smooth internal wiring channel with liquid-tight covering of flexible polyvinyl chloride (PVC). It shall be furnished with a sealing O-ring where entering an enclosure subject to moisture. Where O-Rings are used, ground type bushings shall be used in the box or enclosure.

I. Nonmetallic conduit and fittings shall be suitable for temperature rating of conductor but not less than 90°C. Nonmetallic conduit and fittings shall be molded of high impact PVC compound having noncombustible, nonmagnetic, non-corrosive and chemical resistant properties and shall be of the same manufacturer. Solvent cement shall be of the same manufacturer as the conduit and shall be of the brush-on type. Spray solvents are prohibited. PVC coated metallic fittings shall not be permitted for PVC conduit connections.

J. ENT is not acceptable.

K. Provide strain relief fittings as manufactured by OZ for cables in vertical raceways.

L. Crimp or set-screw type fittings are not acceptable.

M. Minimum conduit size shall be 3/4-inch for branch circuits.

N. Minimum conduit size shall be 1-inch for feeders.

O. 1/2-inch flexible metal conduit may only be used for light fixture whips for lay-in fixtures. Minimum length 3'-0", maximum length 6'-0".

P. MC Cable may be utilized for 120V, 20A branch circuits and lighting circuits where installed above accessible ceilings and within interior walls. It's use is acceptable only between last junction box and the wiring device or fixture. Home runs back to panel (source) shall be installed in conduit.

2.03 WALL AND CEILING OUTLET BOXES

A. Galvanized steel interior outlet wiring boxes of the type, shape and size, including depth of box, to suit each respective location and installation; constructed with stamped knockouts in back and sides, and with threaded holes with screws for securing box covers or wiring devices.
   1. Outlet box accessories as required for each installation, including mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, compatible with outlet boxes, compatible with outlet boxes being used and meeting requirements of individual situations.
   2. Provide multi-gang outlets of single box design. Sectional boxes are not acceptable. Provide outlet boxes of sufficient volume to accommodate the number of conductors entering the box in accordance with the requirements of NEC, and not less than 1-1/2 inch deep unless shallower boxes are required by structural conditions and are approved by the A/E.

B. Outlets exposed to rain shall be equipped with cast metal in-use cover.

C. Provide 4-inch octagonal ceiling outlet boxes.

D. Surface mounted outlet boxes in interior locations shall be threaded cast type.

2.04 PULL AND JUNCTION BOXES

A. Boxes shall be galvanized sheet metal conforming to ANSI/NEMA OS 1 with screw-on cover and welded seams, stainless steel nuts, bolts, screws and washers.

B. Boxes larger than 24 inches in any dimension shall be panelboard code gauze galvanized steel with hinged cover.

C. Boxes shall be sized in accordance with NEC.

PART 3 EXECUTION

3.01 INSTALLATION - CONDUIT

A. Install products as indicated, in accordance with the applicable requirements of NEC, NEMA and the National Electrical Contractors Association's "Standard of Installation".

B. Cut conduit square using a saw or pipe cutter. De-burr cut ends. Joints in steel conduit must be painted with T&B Kopr shield and drawn up tight. Threads for rigid metal conduit and IMC shall be deep and clean. Running threads shall not be used. Wipe plastic conduit clean and dry before joining. Apply full, even coat of cement with brush to entire area that will be inserted into fitting. Let joint cure for 20 minutes minimum. Spray type of cement is not acceptable. Install raceway and conduit system from point of origin in outlets shown, complete with support assemblies including all necessary hangers, beam clamps, hanger rods, turnbuckles, bracing, rolls, clips angles, through bolts, brackets, saddles, nuts, bolts, washers, offsets, pull boxes, junction boxes and fittings to ensure a complete functional raceway system. Where vertical drops of conduit are made to equipment in open space, the vertical conduit shall be rigidly supported from racks supported on the floor.

C. Raceway and conduit system shall be installed parallel and perpendicular to building lines unless indicated otherwise on the drawings.

D. Install rigid wall hot-dipped galvanized steel conduit or hot-dipped galvanized intermediate metal conduit for service entrance, feeders, wall or floor penetrations, mechanical rooms, electrical rooms, exposed interior locations, exposed outdoor locations, damp locations or any location as per design drawing. The following exceptions permitted:
   1. EMT
      a. In sizes up to and including 4 inch, may be used inside dry locations where concealed above accessible ceilings or in dry wall partitions. EMT may not be used outside, in vault, in concrete, underground, in under floor spaces, in masonry walls, in locations likely to be damp, or where exposed. EMT may be exposed in mechanical and electrical rooms where above 5’-0” AFF, but cannot be used for service entrance.
   2. PVC (underground use only)
      a. Install PVC schedule 40 conduit where direct buried in earth.
      b. Underground 90s shall be long radius fiberglass.
      c. Stub-ups shall be schedule 40 PVC.
   3. Liquid-tight
      a. Install liquid-tight flexible metal conduit for connections to rotating, vibrating, moving or movable equipment, including mechanical equipment. Install external ground wire on flexible conduit with grounding bushings. Maximum length shall be 6 feet minimum of 2 feet.
   4. Flexible Metal Conduit
      a. Install standard flexible metal conduit (not liquid-tight), which shall be only used for lighting fixture whips with internal ground wire. Maximum length shall be 6 feet minimum of 3 feet; and minimum size shall be 1/2-inch for lay-in light fixture whips.

E. Install conduits parallel and supported on Unistrut, or equal, trapezes and anchored with split ring hangers, conduit straps or other devices specifically designed for the purpose. No raceways or boxes shall be supported using wire. Arrange conduit to maintain headroom and present a neat appearance. Conduit routes shall follow the contour of the surface it is routed on. Route exposed conduit and tray above accessible ceilings parallel and perpendicular to walls and adjacent piping. Maintain 12-inch clearance between conduit and heat sources, such as flues and heating appliances. Wire ties or “wrap lock” are not permitted to support or secure conduit system. Fasten conduit with the following material:
   1. Wood screws on wood
   2. Toggle bolts on hollow masonry
   3. Bolts and expansion anchors in concrete or brick
   4. Machine screws, threaded rods and clamps on steel

5. Conduit clips on steel joists.
6. 4 inch x 4 inch penta-treated pine installed in pitch pans on roof, spaced at intervals not to exceed 5 feet. Do not install on roof without written permission from Owner. Conduits to rooftop equipment shall be installed in ceiling space and penetrate roof within equipment curb.

F. Install conduits outside of building lines at a minimum depth of 30 inches below finished grade. Refer to ductbank details for additional depth requirements. Provide additional depth as required to maintain required separation from other utilities and to avoid obstructions. Maintain twelve inches earth or two inches concrete separation between electrical conduits and other services or utilities underground.

G. Allow minimum 6” clearance from heat sources.

H. Conduits running to rooftop and exterior wall mounted equipment shall be routed inside building and stubbed out at equipment.

I. Install underground conduits with sealing glands equal to OZ Type FSK exterior to the conduit and OZ type CSB, or equal internally at the point where conduits enter the building to prevent water seepage into the building.

J. Fittings shall be approved for grounding purposes or shall be jumpered with copper grounding conductors of appropriate ampacity. Leave termination of such jumpers exposed.

K. Install expansion fittings in metal and PVC conduit as follows:
   1. Conduit Crossing Building Expansion Joints:
      a. EMT all sizes
      b. IMC all sizes
      c. RMC all sizes
   2. Conduits entering environmental rooms and other locations subject to thermal expansion and as required by NEC.
   3. Unless expansion fitting has an integral bonding braid, as in Crouse-Hinds Type XC, a green insulated grounding conductor shall be pulled in the conduit. Both ends of the green grounding conductors shall be accessible for inspection.

L. Install conduit concealed in walls, partitions and above ceilings. Install conduit exposed in ceiling area (at structure) of electrical rooms and mechanical rooms.

M. Horizontal runs of conduit within walls is not permitted.

N. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.

O. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture if cable or wire are not installed immediate after conduit run. Tape covering conduit ends is not acceptable.

P. Provide 200 lb. nylon cord full length in empty conduit.

Q. Where conduit penetrates fire-rated walls and floors, provide pipe sleeve two sizes larger than conduit; pack void around conduit with oakum and fill ends of sleeve with fire-resistive compound or provide mechanical fire-stop fittings with UL listed fire-rating or seal opening around conduit with UL listed foamed silicone elastomer compound equal to fire-rating of floor or wall.

R. Install no more than the equivalent of three 90-degree bends between boxes. Where four 90 degree bends are required, prior approval by the Engineer is required. Use conduit bodies to make sharp changes in direction, as around beams. Conduit bodies shall be readily accessible and sized for the cables installed. Running or rolling offsets are not approved. Use factory long radius elbows for bends in conduit larger than 2-inch size. All parallel bends shall be concentric.

S. Pull string shall be provided full length in conduit designated for future use.

T. Rigid steel conduit shall be taped where in contact with concrete. At the points where conduit penetrates concrete that is in contact with soil, the conduit shall be Schedule 80 PVC bedded in sand.

3.02 INSTALLATION - WIREWAYS

A. Bolt wireways to steel channels fastened to the wall or in self-supporting structure. Install level.

B. Gasket each joint in oil-tight wireway.

C. Mount rain tight wireway for exterior installation in horizontal position only.

3.03 INSTALLATION - BOXES

A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.

B. Provide outlet box accessories as required for each installation, including mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, compatible with outlet boxes being used and meeting requirements of individual situations.

C. Electrical box locations shown on Contract Drawings are approximate unless dimensioned. Verify location of outlets prior to rough-in.

D. Allow minimum 6” clearance from heat sources.

E. Locate and install boxes to allow access, minimum 12 inches above ceiling except where space dimensions do not allow.

F. Do not install boxes back-to-back in walls. Provide minimum 6-inch separation. Provide minimum 24-inch separation in acoustic-rated walls. If boxes are connected together, install flexible connection between the two and pack openings with fiberglass.

G. Secure boxes rigidly to the substrate upon which they are being mounted, or solidly imbed boxes in concrete or masonry. Do not support junction boxes from the raceway systems. Boxes shall not be permitted to move laterally. Boxes shall be secured between two studs. Box may be supported to one stud only if installed using Erico Caddy H23/H4/HS3 Series box support with leg to prevent box from moving in stud wall.

H. Provide knockout plugs for unused openings.

I. 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.

J. Install boxes in walls without damaging wall insulation.

K. Outlet boxes in plaster partitions shall be "shallow-type" set flush in wall so there is at least 5/8 inch plaster covering back of box.

L. Outlet boxes for switch shall not be used as junction boxes.

M. Coordinate mounting heights and locations of outlets mounted above counters, benches and backsplashes.

N. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaire, to be accessible through luminaire ceiling opening.

O. Outlet boxes supporting fixtures shall be securely anchored in place in an approved manner. Support outlet boxes and fixtures in acoustic ceiling areas from building structures, not from acoustic ceilings. Lighting fixture outlets shall be coordinated with mechanical and architectural equipment and elements to eliminate conflicts and provide a workable neat installation.

3.04 WALL AND FLOOR PENETRATIONS

A. Core drilling shall be approved by Owner prior to execution. X-ray for each required floor penetration. Avoid anchor bolt on structural column by installing “column hugging” type of unistrut support for electrical installation. PVC shall not be used for wall and floor penetration.

B. Route conduit through roof openings for piping and ductwork where possible; otherwise, route through roof jack with pitch pocket. Coordinate roof penetrations with the roofing contractor.

END OF SECTION

SECTION 26 05 53
ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 WORK INCLUDED

A. Nameplates and tape labels

B. Wire and cable markers

C. Conduit color coding and labeling

1.03 REFERENCES

A. NFPA 70 - National Electrical Code (latest edition)

1.04 SUBMITTALS

A. Provide submittals in accordance with and in addition to Section 260000, Basic Electrical Requirements, and Division 01 for submittal requirement.
   1. Furnish nameplate identification schedules listing equipment type and nameplate data with letter sizes and nameplate material.

PART 2 PRODUCTS

2.01 MATERIALS

A. Equipment Nameplates:
   1. For normal power electrical equipment, provide engraved three-layer laminated plastic nameplates, engraved white letters on a black background.
   2. For emergency equipment provide engraved three-layer laminated plastic nameplates with engraved white letters on a red background.
   3. For fire alarm system provide engraved three-layer laminated plastic nameplates with white letters on a yellow background.

B. Underground Warning Tape
   1. Manufactured polyethylene material and unaffected by acids and alkalines.
   2. 3.5 mils thick and 6 inches wide.
   3. Tensile strength of 1,750 psi lengthwise.
   4. Printing on tape shall include an identification note BURIED ELECTRIC LINE, and a caution note CAUTION. Repeat identification and caution notes over full length of tape. Provide with black letters on a red background.

C. Conductor Color Tape and Heat Shrink:
   1. Colored vinyl electrical tape shall be applied perpendicular to the long dimension of the cable or conductor.
   2. In applications utilizing tray cable, heat shrinkable tubing shall be used to obtain the proper color coding for the length of the conductor in the cabinet or enclosure. Variations to the cable color coding due to standard types of wire or cables are not acceptable.

D. Warning labels: Provide warning labels with black lettering on red background with a minimum of 1/2" lettering.

E. Receptacle, lighting control, and switch cover plates shall be custom engraved with panel and circuit breaker number. Stick-on tape label is not acceptable.

F. J-Box cover plate labels (existing and new J-boxes): Black stenciled letters 1/4" high. Adhesive back tapes may be used if a clear tape is applied over the label for protection. Each J-box cover shall be labeled with voltage and each circuit number contained in J-box.

1. White letters on black background for normal power.
2. White letters on red background for emergency/standby power.

PART 3 EXECUTION

3.01 INSTALLATION

A. Degrease and clean surfaces to receive nameplates or tape labels.

B. Install nameplates parallel to equipment lines.

C. Secure plastic nameplates to equipment fronts using screws or rivets. Use of adhesives shall be per Owner's approval. Secure nameplate to outside face of flush mounted panelboard doors in finished locations.

3.02 WIRE IDENTIFICATION

A. Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identify with branch circuit or feeder number for power and lighting circuits. Label control wire with number as indicated on schematic and interconnection diagrams or equipment manufacturer's shop drawings for control wiring.

B. Conductors for power circuits to be identified per the following schedule. Verify existing color code and notify Engineer if different than below.

	SYSTEM VOLTAGE	SYSTEM VOLTAGE
Conductor	208/120V	480/277V
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Gray
Grounding IG	Green Green w/Yellow	Green Green w/Yellow

C. Match existing color code if different than above.

3.03 NAMEPLATE ENGRAVING SCHEDULE

A. Provide nameplates of minimum letter height as scheduled below. Nameplates shall be same as equipment names indicated on the Drawings.

B. Individual Circuit Breakers in Switchboards, Distribution Panelboards, Disconnect Switches, Motor Starters, and Contactors: 1/4-inch; identify source to device and the load it serves, including location.

C. Panelboards: 3/8-inch; identify equipment designation. 1/4 -inch; identify source, voltage and bus rating.

3.04 SWITCHGEAR LABEL

A. Switchgear shall be labeled to include arc-flash labels, personal protective equipment (PPE) and other information as required by NEC 110.16 and as described in the standards and guidelines referenced in FPN Nos. 1 and 2.

END OF SECTION

SECTION 26 05 73
SYSTEM COORDINATION AND ANALYSIS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 WORK INCLUDED

A. Provide a complete analysis of the operation of the electrical power system under overcurrent and short circuit conditions (L-G, L-L and 3Ø bolted fault).

B. Include new breakers, panels, and other electrical equipment.

C. Provide complete arc-flash study and equipment labeling.

1.03 SUBMITTALS

A. Analysis shall be performed by one of the following:
   1. Square D Systems Coordination Group
   2. Coordinated Power Systems - Hales Corner, Wisconsin
   3. Eaton
   4. Siemens

B. Submit a preliminary analysis of the system for approval prior to a release for fabrication of electrical equipment.

C. Submit final analysis of the system prior to the installation or energization of equipment.

1.04 REFERENCED STANDARDS

A. The analysis of overcurrent operation shall be based on IEEE "Overcurrent Protective Device Coordination by Computer".

B. The analysis of short circuit current operation shall be based on IEEE "Procedure for Determining Maximum Short Circuit Value in Electrical Distribution Systems".

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01 SCOPE OF ANALYSIS

A. The analysis shall be comprehensive from Northwest Substation, through new Vista switchgear, to oil-filled pad mounted transformers through the distribution system to the last overcurrent device serving equipment or outlets.

B. The contribution of all motors one horsepower and larger shall be included.

C. Include generator, automatic transfer switches and controls.

D. Where operation from one or more sources is possible, all operating configurations shall be analyzed.

3.02 BASIS OF COMPUTATION

A. Computation shall be based on infinite bus method. For arc-flash ratings, use actual available fault current values to determine recommended rating.

B. Device characteristics and equipment impedances shall be obtained in writing from the equipment supplier.

C. The preliminary analysis shall be based on the Contractor's estimation of feeder types and lengths and the proposed equipment characteristics.

D. The final analysis shall be based on the equipment and materials actually installed at the project. Conductor and raceway type, lengths, and characteristics shall be supplied by the Contractor on the actual materials and routings to be installed.

E. Coordination TCC's shall include all pertinent data including MAG-I, FLA, cable damage limit, fault current, partial one-line of devices plotted, motor stall, etc.

3.03 RESULTS

A. The overcurrent device coordination analysis shall present a graphic representation of the required time-current settings for every protective device in the system and a tabular listing for equipment calibration. All devices which are not able to be fully selectively coordinated shall be noted along with recommended action.
   1. All corrective action shall be included in bid.
   2. Provide mission critical breakers or breakers with additional trip features as required for code required coordination.

B. The short circuit analysis shall list the phase and ground fault current available at each switchgear, switchboard and panelboard bus in the system, and define whether each device in the system is adequately rated for the duty imposed. Contractor shall furnish equipment with AIC rating which exceeds maximum available fault current regardless of rating specified on drawings. Equipment ratings on drawings are minimum AIC duty and shall not be reduced.

C. Series rating is not permitted.

D. Label switchgear based on results of arc-flash study.

3.04 DEVICE FEATURES, SIZES AND RATINGS

A. In accordance with coordination study and arc-flash study, provide all “recommended” and “required” device features, sizes and ratings at no additional cost including but not limited to:
   1. NEC arc-energy reduction. Provide equipment and/or breaker features as necessary to limit arc-flash energy per NEC.
   2. Emergency branch coordination.
   3. Other protection or coordination issues.
   4. Provide mission critical breakers or breakers with additional trip features as required for code required coordination.

END OF SECTION

SECTION 26 09 36
MODULAR DIMMING CONTROLS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Ceiling mounted occupancy/vacancy sensors including dual technology, microphonic, and passive infrared technologies. This includes self-contained PIR sensors as well as low voltage sensors that work with switchpacks.
   2. Wall mounted lighting control stations.

1.03 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.

B. ASTM International (ASTM) (www.astm.org)
   1. D4674 - 02a Standard Test Method for Accelerated Testing for Color Stability of Plastics Exposed to Indoor LED, Fluorescent Lighting, and Window-Filtered Daylight.

C. Canadian Standards Association (CSA) (www.csa.ca).
   1. CSA C22.2 # 14 Industrial Control Equipment
   2. CSA C22.2 # 184 Solid-State Lighting Controls
   3. CSA C22.2 # 156 Solid-State Speed Controls

D. International Electrotechnical Commission (www.iec.ch).
   1. (IEC) 801-2 Electrostatic Discharge Testing Standard.
   2. IEC/EN 60669-2-1 Switches for household and similar fixed electrical installations - electronic switches.

E. International Organization for Standardization (ISO) (www.iso.ch):
   1. 9001:2000 - Quality Management Systems.

F. National Electrical Manufacturers Association (NEMA) (www.nema.org)
   1. WD1 (R2005) - General Color Requirements for Wiring Devices.

G. Underwriters Laboratories, Inc. (UL) (www.ul.com):
   1. 94 - Flammability Rating
   2. 916 - Energy Management Equipment.
   3. 508 (2005) - Standard for Industrial Control Equipment.
   4. 244A - Appliance Controls

1.04 SYSTEM DESCRIPTION

A. Permanently Installed
   1. Ceiling mounted occupancy/vacancy sensors
   2. Switchpacks
   3. Wall mounted lighting control stations

1.05 SUBMITTALS

A. Submit under provisions of Section 013300.

B. Specification Conformance Document: Indicate whether the submitted equipment:
   1. Meets specification exactly as stated.

2. Meets specification via an alternate means and indicate the specific methodology used.

C. Shop Drawings shall include:
   1. Load schedule indicating actual connected load, load type, and voltage per circuit, circuits and their respective control zones, circuits that are on emergency, and capacity, phase, and corresponding circuit numbers.
   2. Schematic of system.
   3. Lighting plan clearly marking product type, location and orientation of each sensor.

D. Product Data: Catalog specification sheets with performance specifications demonstrating compliance with specified requirements.

1.06 QUALITY ASSURANCE

A. Manufacturer: Minimum 15 years experience in manufacture of occupancy/vacancy sensor lighting controls.

B. Manufacturer's Quality System: Registered to ISO 9001:2000 Quality Standard, including in-house engineering for product design activities.

C. Occupancy/vacancy Sensing Lighting Controls:
   1. Listed by UL specifically for the required loads. Provide evidence of compliance upon request.

D. Installer Qualifications: Installer shall be one who is experienced in performing the work of this section, and who has specialized in installation of work similar to that required for this project.

E. Source Limitations: To assure compatibility, obtain occupancy/vacancy sensors from a single source with complete responsibility over all lighting controls, including accessory products. The use of subcontracted component assemblers is not acceptable.

1.07 PROJECT CONDITIONS

A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
   1. Ambient temperature: 0° to 40°C (32° to 104°F).
   2. Relative humidity: Maximum 90 percent, non-condensing.
   3. Occupancy/vacancy Sensors must be protected from dust during installation.

1.08 WARRANTY

A. Provide manufacturer's 5 year parts warranty.

1.09 MAINTENANCE

A. Make ordering of new equipment for expansions, replacements, and spare parts available to end user.

B. Make new replacement parts available for minimum of ten years from date of manufacture.

C. Provide factory direct technical support.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturer: Acuity Brands Lighting, Inc. – nLight

2.02 SENSOR PERFORMANCE REQUIREMENTS

A. Sensing Mechanism:
   1. Occupancy sensors shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.
   2. Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state, thus preventing false on conditions. Ultrasonic or Microwave based sensing technologies are not acceptable.

3. For applications where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions), a sensor with an additional “dual” technology shall be used.
4. Dual technology sensors shall have one of its two technologies not require motion to detect occupancy. Acceptable dual technology includes PIR/Microphonics (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants. Sensors where both technologies detect motion (PIR/Ultrasonic) are not acceptable.
5. All sensing technologies shall be acoustically passive, meaning they do not transmit sounds waves of any frequency (for example in the Ultrasonic range), as these technologies have the potential for interference with other electronic devices within the space (such as electronic white board readers). Acceptable detection technologies include Passive Infrared (PIR), and/or Microphonics technology. Ultrasonic or Microwave based sensing technologies are not acceptable.

B. Power Failure Memory:
1. Controls incorporate non-volatile memory. Should power be interrupted and subsequently restored, settings and parameters saved in protected memory shall not be lost.

C. Designed and tested to withstand discharges without impairment of performance when subjected to discharges of 15,000 volts per IEC 801-2.

D. Coverage Patterns are tested and verified using the NEMA WD 7 Standard.

E. Sensor shall have time delays from 10 to 30 min.

F. When required, sensors shall automatically adjust time delay and sensitivity settings.

G. 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.

H. 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.

I. Where required, 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.

2.03 CEILING MOUNTED SENSORS (LOW VOLTAGE)

A. Product CM 9, CM 10, CM PDT 9, CM PDT 10, as well as nLight Series

B. Provide all necessary mounting hardware and instructions.

C. Sensors shall be Class 2 devices.

D. Provide an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options.

E. Where required, sensors shall offer integral Bi-level Automatic-On (just one lighting level comes on automatically when occupancy/vacancy is detected)

F. Shall utilize Zero Crossing Circuitry which increases relay life, protects from the effects of inrush current, and increases sensor’s longevity.

G. Shall have no leakage current to load for safety purposes and shall have voltage drop protection.

H. Where required, shall offer zero time delay mode and be able to actuate the output for one second to signal another device that the space being monitored is occupied. Applications may include the use of a lighting control system to manage the delay of the lighting deactivation.

I. Shall have a Tracking/HVAC mode that allows the load connected to the Form C BAS relay to remain on when the lights are turned off manually.

J. Walk through feature shall shut off lights within 2 minutes after momentary occupancy/vacancy.

K. Sensors shall be RoHS compliant.

2.04 SENSOR SWITCHPACKS

A. Product: MP-20, PP-20, nPP16 and nPP16D

B. Control wiring between sensors and control units shall be Class 2, 18-24 AWG, stranded U.L. Classified, PVC insulated in conduit.

C. Integrated, self-contained unit consisting internally of an isolated load switching control relay and a power supply to provide low-voltage power.

D. Shall be compatible with magnetic or electronic low voltage, and magnetic or electronic fluorescent, as well as motor loads.

2.05 MODULAR SYSTEM WALL SWITCHES AND DIMMERS

A. Devices shall recess into single-gang switch box and fit a standard GFI opening.

B. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.

C. All devices shall have two RJ-45 ports.

D. All devices shall provide toggle switch control. Dimming control and low temperature/high humidity operation are available options.

E. Devices shall be white.

F. Devices with mechanical push-buttons shall provide tactile and LED user feedback.

G. Devices with mechanical push-buttons shall have custom button labeling.

H. Wall switches and dimmers shall be the following nLight model numbers, with device options as specified:
   1. nPODM (single on/off, push-buttons, LED user feedback)
   2. nPODM DX (single on/off, single dimming raise/lower, push-buttons, LED user feedback)
   3. nPODM 2P (dual on/off, push-buttons, LED user feedback)
   4. nPODM 2P DX (dual on/off, dual dimming raise/lower, push-buttons, LED user feedback)
   5. nPODM 4P (quad on/off, push-buttons, LED user feedback)
   6. nPODM 4P DX (quad on/off, quad dimming raise-lower, push-buttons, LED user feedback)

2.06 SOURCE QUALITY CONTROL

A. Perform full-function testing on 100% of all system components and panel assemblies at the factory.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install equipment in accordance with manufacturer’s installation instructions.

B. Provide complete installation of system in accordance with Contract Documents.

C. Provide equipment at locations and in quantities indicated on Drawings. Provide any additional equipment required to provide control intent.

D. Sensors shown on drawings are minimum quantity to be provided. Provide additional occupancy/vacancy sensors as required to provide full (100%) room coverage.

3.02 TESTING

A. Upon completion of all wiring and after all fixtures are installed and lamped, a representative shall check the installation prior to energizing the system. Each installed occupancy/vacancy sensor shall be tested in the test mode to see that lights turn off and on based on occupancy/vacancy.

B. At the time testing, the owner's representative shall be thoroughly instructed in the proper operation of the system.

END OF SECTION

SECTION 26 22 13
DRY TYPE TRANSFORMERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 WORK INCLUDED

A. This Section includes enclosed dry type distribution transformers rated 600 volts and less, sizes up to 500 kVA.
   1. Dry type Two-Winding transformers.

1.03 REFERENCES

A. NEMA ST 1 - Specialty Transformers (Except General Purpose Type)

B. NEMA ST 20 - Dry Type Transformers for General Applications

C. IEEE C57.12.01 - General Requirements for Dry-Type Distribution and Power Transformers

D. IEEE C57.12.91 - Test Code for Dry-Type Distribution and Power Transformers

E. IEEE C57.96 - Guide for Loading Dry-Type Distribution and Power Transformers

F. IEEE Std. 519 - Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems

G. UL 506 - Specialty Transformers

H. UL 1561 - Dry Type General Purpose and Power Transformers

I. NEMA TP 1 - Guide for Determining Energy Efficiency for Distribution Transformers

J. NEMA TP 2 - Standard Test Method for Measuring the Energy Consumption for Distribution Transformers

1.04 SUBMITTALS

A. Provide submittals in accordance with and in addition to Section 260000, Basic Electrical Requirements, and Division 01 for submittal requirement.

B. Submit manufacturer's data on dry type transformers, vibration isolators and accessories.

C. Include outline and support point dimensions of enclosures and accessories; unit weight; voltage; kVA; impedance ratings and characteristics; loss data; efficiency at 25, 50, 75 and 100 percent rated load; sound level; tap configurations; insulation system type, and rated temperature rise.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Store transformers in a clean and dry space and protected from weather in accordance with manufacturer’s instructions. Cover ventilating openings to keep out dust.

B. Transformer shall not be used as work tables, scaffolds or ladders.

C. Handle transformers carefully to avoid damage to material components, enclosure and finish. Use only lifting eyes and brackets provided for that purpose. Damaged transformers shall be rejected and not be installed on project.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Transformers shall be of dry type complying with the design function requirements of the project. Design characteristics shall be as noted in manufacturer's submittal data.

B. Provide barrel type coils vacuum impregnated with high grade insulating varnish, non-hydroscopic thermo-setting type.

C. Furnish copper windings, continuous without splice. Provide deduct alternate for aluminum windings.

D. Use non-aging silicon steel cores held together with steel channels or angles, with low flux density, quiet operating, and vibration isolated from enclosure and support channels.

E. All transformers shall be designed, manufactured, and tested in accordance with all the latest applicable ANSI, NEMA, IEEE and UL standards, and shall be UL listed and bear the UL label.

2.02 DRY TYPE TWO-WINDING TRANSFORMERS (K-4 RATED)

A. Acceptable manufacturers
   1. Eaton
   2. Square D
   3. Siemens

B. Dry type transformers shall be K-4 rated, NEMA ST 20; factory-assembled, air cooled dry type transformers; ratings as shown on the Drawings.

C. Insulation system and average winding temperature rise (in a 40 degree C maximum ambient) for rated kVA as follows:

kVA Rating	Insulation Class (degree C)	Temperature Rise (degree C)
1-15 kVA	185	115
25-500 kVA	220	115

D. The maximum temperature of the top of the enclosure shall not exceed 50 degrees C rise above a 40 degree ambient.

E. Winding Taps, Transformers 15 kVA and Less: Two 5 percent below rated voltage, full capacity taps on primary winding.

F. Winding Taps, Transformers 25 kVA and Larger: Two 2.5 percent above rated voltage and four 2.5 percent below rated voltage, full capacity taps on primary.

G. Sound Levels: Maximum sound levels are as follows:

kVA Rating	Sound Level
0-9	40 db
10-50	45 db
51-150	50 db
151-300	55 db
301-500	60 db

H. Basic impulse level shall be 10 KV.

I. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

J. Transformers 75 kVA and less shall be suitable for wall, floor, or trapeze mounting; transformers larger than 75 kVA shall be floor mounted.

K. Enclosure shall be NEMA Type 2 or as shown on the Drawings. Provide lifting eyes or brackets.

L. Nameplate on transformer shall include transformer connection data, kVA ratings, impedance, and overload capacity based on rated allowable winding temperature rise. Identify primary and secondary voltages.

M. Isolate core and coil from enclosure using vibration absorbing mounts.

N. Provide identification nameplate in accordance with Section 260553, Electrical Identification.

PART 3 EXECUTION

3.01 INSPECTION

A. Installer shall examine the areas and conditions under which dry type transformers are to be installed and notify the contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install dry type transformers as indicated, in accordance with the applicable requirements of the NEC and the National Electrical Contractors Association's "Standard of Installation".

B. Check for damage and tight connections prior to energizing transformer.

C. Measure primary and secondary voltages and make appropriate tap adjustments.

D. Set transformer plumb and level.

E. Use flexible liquid-tight conduit, 2 ft. minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

F. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.
   1. For floor transformer installations, use one pad type Korfund Elasto-Grip, waffle, or equal, at each corner of the transformer, sized for load of 50 lbs./sq. in.
   2. For wall hung transformer installations, use spring type Korfund Series P, or equal. Provide sound pads at each corner of the transformer, sized for 1/2 inch deflection.

G. Avoid mounting transformers in areas where tend to amplify noises, such as stairways, hall areas, and corners near ceilings. Avoid where possible, nearby reflecting object or enclosure that might resonate or echo.

H. Ground transformers in accordance with Section 260526 Grounding and NEC requirements.

END OF SECTION

SECTION 26 24 16
PANELBOARDS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 WORK INCLUDED

A. Distribution panelboards.

B. Branch circuit panelboards.

1.03 REFERENCES

A. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.

B. NAME KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

C. NEMA PB 1 - Panelboards.

D. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

E. NEMA PB 1.2 - Application Guide for Ground-fault Protective Devices for Equipment.

F. NEMA AB 3 - Molded Case Breakers and Their Application

G. ANSI/UL 67 - Electric Panelboards

H. ANSI/UL 50 - Cabinets and Boxes

I. ANSI/UL 508 - Industrial Control Equipment

1.04 SUBMITTALS

A. Provide submittals in accordance with and in addition to Section 260000, Basic Electrical Requirements, and Division 01 for submittal requirement.

B. Submit dimensioned drawings showing size, circuit breaker arrangement and equipment ratings including, but not limited to, voltage, main bus ampacity, integrated short circuit ampere rating, and temperature rating of circuit breaker terminations.

C. Submit 1/4” scale drawing of each electrical room and other rooms with electrical equipment to demonstrate that all equipment being submitted will fit in the space and all clearances are obtained. This drawing must be included with the submittal for equipment specified in this section.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver distribution panelboards in factory-fabricated water-resistant wrapping.

B. Handle panelboards carefully to avoid damage to material component, enclosure and finish.

C. Store in a clean, dry space and protected from the weather.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Square D Company

B. Eaton

C. Siemens

2.02 PANELBOARD CONSTRUCTION

A. General: Provide flush or surface mounted, circuit breaker type distribution or branch circuit panelboards with electrical ratings and configurations, as indicated on the drawings and schedules. Load center type panelboards are not acceptable.

B. Enclosure:
   1. Enclosure shall be proper NEMA type as indicated.
   2. NEMA 1 (Indoors)
      a. Back box shall be galvanized steel for flush mounted branch circuit panelboards. Back box shall have gray enamel electro-deposited finish over cleaned phoshatized steel for all other type panelboards.
      b. Provide panelboard fronts with door-in-door cover.
   3. Construct cabinet in accordance with UL 50. Use not less than 16-gauge galvanized sheet steel, with all cut edge galvanized. Provide a minimum 4-inch gutter wiring space on each side. Provide large gutter where required to accommodate the size and quantity of conductors to be terminated in the panel, and where required by code.
   4. Exterior and interior steel surfaces shall be cleaned and finished with gray enamel over rust inhibiting phosphatized coating. Color shall be ANSI 61 gray.
   5. Doors shall be equipped with flush-type combination catch and key lock. All locks shall be keyed alike.
   6. Branch circuit panelboards shall be 5-3/4-inches deep.
   7. A directory holder with heavy plastic plate, metal frame, and index card shall be mounted inside of each door.
   8. Reinforce enclosure and securely support bus bars and overcurrent devices to prevent vibration and breakage in handling.
   9. Rating: Minimum integrated short-circuit rating, voltage and current rating as shown on drawings.
   10. Labeling: The Contractor shall furnish and install engraved, laminated plastic nameplates on the trim per Section 260553, Electrical Identification

C. Bus:
   1. Provide panelboards with copper rounded edge phase, neutral and ground buses, rated full capacity as scheduled on drawings. Buses shall be full-length and braced for the maximum available fault current as shown on drawings.
   2. Phase bussing shall be stacked front-to-back, A-B-C.
   3. The neutral and ground bus bars shall have termination locations for each of the individual feeders and the lugs sized appropriately. In addition, space shall be provided to terminate the neutrals and grounds in two feeders equal to the largest size circuit breaker that can be installed in the panelboard. The ground bus shall be mounted in the panelboard, opposite the incoming line and neutral lugs and shall be accessible to allow easy installation of bolts, nuts and lock washers used to attach ground lugs. The neutral and ground buses in branch circuit panelboards shall have spaces to terminate 42 neutral and 42 ground wires.
   4. All lugs for phase, neutral, and ground buses shall be tin-plated copper.
   5. Neutral and ground buses shall be tin-plated copper.

2.03 SWITCHING AND OVERCURRENT PROTECTIVE DEVICES

A. Provide molded case circuit breakers with manufacturer’s standard construction, bolt on type, with integral inverse time delay thermal and instantaneous magnetic trip in each pole. Circuit breakers shall be constructed using glass reinforced polyester insulating material providing superior dielectric strength. Provide circuit breakers UL listed as Type HACR for air-conditioning equipment branch circuits.

B. Circuit breakers shall have an over center, trip-free, toggle operating mechanism that will provide a quick-make, quick-break contact action.

C. Piggyback breakers are not permitted.

D. Provide handle padlock attachments on circuit breakers where required. Device shall be capable of accepting a single padlock. All circuit breakers shall be capable of being individually padlocked in the off position.

E. The circuit breakers shall be connected to the bus by means of solidly bolted connection. In multi-pole breakers, the phase connections on the bussing shall be made simultaneously without additional connectors or jumpers. Multi-pole breakers shall be two or three pole as specified. Handle ties are not permitted. The circuit breaker shall have common tripping for all poles.

F. All circuit breakers shall be provided with visible ON and OFF indications.

G. Provide GFI circuit breakers as indicated on drawing and per NEC requirement.

H. Breaker voltage and trip rating shall be per drawings. Breaker faceplate shall indicate UL certificate standards with applicable voltage systems and corresponding short current rating as per drawings.

I. Molded Case Circuit Breakers:
   1. Breakers 400 ampere frame and less shall be manufacturer's standard industrial construction, bolt-on type, integral inverse time delay thermal and instantaneous magnetic trip. Breakers 225 ampere through 400 ampere shall have continuously adjustable magnetic pick-ups of approximately five to ten times trip rating.
   2. Breakers 600 ampere frame and above shall be equipped with solid-state trip complete with built-in current transformers, solid-state trip unit and flux transfer shunt trip.

2.04 DEVICE FEATURES, SIZES AND RATINGS

A. In accordance with coordination study and arc-flash study, provide all “recommended” and “required” device features, sizes and ratings at no additional cost including but not limited to:
   1. NEC arc-energy reduction. Provide equipment and/or breaker features as necessary to limit arc-flash energy per NEC.
   2. Emergency branch coordination.
   3. Other protection or coordination issues.
   4. Provide mission critical breakers or breakers with additional trip features as required for code required coordination.

2.05 SURGE PROTECTION

A. Surge protective devices (SPD) shall be installed at each new distribution panel. Include 3-pole breaker in panelboard and conduit/conductors to surge protective device. Breaker and conduit/conductors shall be size as recommended by manufacturer. Breaker is not shown on panel Schedule.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Square D
   2. Eaton
   3. Siemens

C. Surge Protection Device: IEEE C62.41-compliant, integrally mounted, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the panelboard short-circuit rating, and with the following features and accessories:
   1. Fabrication using bolted compression lugs for internal wiring.
   2. Integral disconnect switch.
   3. Redundant suppression circuits.
   4. Redundant replaceable modules.
   5. Arrangement with wire connections to phase buses, neutral bus, and ground bus.

6. LED indicator lights for power and protection status.
7. Audible alarm, with silencing switch, to indicate when protection has failed.
8. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Integrate with building automation system.
9. Six-digit, transient-event counter set to totalize transient surges.

D. Minimum Surge Current Capability (single pulse rated) per phase:
1. Panelboards: 100 kA

E. SPD shall be UL labeled as Type 1 (verifiable at UL.com), intended for use without need for external or supplemental overcurrent controls. Every suppression component of every mode, including N-G, shall be protected by internal overcurrent and thermal over-temperature controls.

F. SPD shall provide surge current paths for all modes of protection: L-N, L-G, and N-G for Wye systems; L-L, L-G in single phase systems.

G. UL 1449 Third Edition Listed Voltage Protection Ratings (VPRs) shall not exceed the following:

System Voltage	L-N	L-G	L-L	N-G
208Y/120	700V	700V	1200V	700V
480Y/277	1200V	1200V	2000V	1200V

H. UL 1449 Third Edition Listed Maximum Continuous Operating Voltage (MCOV):

System Voltage	Allowable System Voltage Fluctuation (%)	MCOV
208Y/120	25%	150V
480Y/277	15%	320V

PART 3 EXECUTION

3.01 INSTALLATION

A. Install panelboards in accordance with manufacturer's written instructions and the applicable requirements of the NEC, NEMA, ANSI and the National Electrical Contractors Association's "Standard of Installation".

B. Anchor enclosed firmly to walls and structural surfaces, ensuring that they are permanently and mechanically secured. Direct attachment to dry wall is not permitted. Freestanding panelboards shall be installed on a concrete housekeeping pad with anchors per manufacturer’s recommendation.

C. Mounting height:
1. Distribution Panelboards: Such that highest operating handle is no greater than 79 inches above finished floor.
2. Branch Circuit Panelboards: Such that highest operating handle is no greater than 79 inches above finished floor.
3. Where panelboards occur in groups, the tops shall be aligned if it can be done without exceeding items 1 and 2 above.

D. Install panelboards plumb. Adjust trim to cover all openings. Seal all conduit openings and cap all used knockout holes.

E. Provide blank plates for unused open spaces in panelboards. Keep the front door closed after work to protect from damage, dirt, and debris at all times.

F. Install identification nameplates in accordance with Section 260553, Electrical Identification.

3.02 FIELD QUALITY CONTROL

A. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers and lugs.

3.03 PANELBOARD SCHEDULE

A. The Contractor shall provide engraved, laminated plastic nameplates for circuit identification as indicated on the Drawings for distribution panelboards.

B. The Contractor shall fill the index directory inside the front door of branch circuit panelboards identifying each existing and new circuit. Where changes are made, the schedule shall reflect the changes. At the end of the job, these schedules shall reflect as-built record conditions.

END OF SECTION

SECTION 26 27 26
WIRING DEVICES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 WORK INCLUDED

A. Wiring Devices:
   1. Wall switches.
   2. Receptacles.
   3. Device plates and box covers.

B. Wiring devices for HVAC in Division 23 shall meet the requirement of this specification.

1.03 REFERENCES

A. Americans with Disabilities Act (ADA)

B. ANSI/NEMA OS 1- Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

C. ANSI/UL 20 - General Use Snap Switches.

D. ANSI/UL 498 - Attachment Plugs and Receptacles.

E. ANSI/UL 943 - Ground Fault Circuit Interrupters.

F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts maximum).

G. NEMA WD 1 - General-Purpose Wiring Devices.

H. NEMA WD 5 - Specific-Purpose Wiring Devices.

I. Texas Accessibility Standards. (TAS)

1.04 SUBMITTALS

A. Provide submittals and Division 01 for submittal requirement.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver wiring devices individually wrapped in factory-fabricated containers.

B. Handle wiring devices carefully to avoid damage, breaking and scoring.

C. Store in a clean dry space and protected from the weather.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide factory fabricated wiring devices in the type and electrical rating for the service indicated. Where type and grade are not indicated, provide proper selection to correspond with branch circuit wiring and overcurrent protection. Attachment of wires to devices shall be by screw pressure under the head of binding screws. Arrangements depending on spring pressure or tension are not acceptable. All binding screws shall be brass or bronze.

B. Device color:
   1. Switches and receptacles on normal power shall be white.
   2. Switches and receptacles on emergency power shall be red.

2.02 WALL SWITCHES

A. Acceptable manufacturers
   1. Arrow-Hart
   2. Hubbell
   3. General Electric

4. Leviton
5. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in 260000 and Division 01 for substitution requirement.

B. Material
1. Wall switches for lighting circuits and motor loads under 1/3 hp shall be AC general use snap switch with toggle handle, 20 amperes and 120 volt AC with number of poles as required; Arrow-Hart 1990 Series.
2. Pilot light type shall be equipped with red toggle handle (glow when on), 20 amperes and 120 volt AC with number of poles as required; Arrow-Hart 1990PL Series.
3. A listed manual switch having a horsepower rating not less than the rating of the motor and marked “Suitable as Motor Disconnect” shall be permitted to serve as disconnect means for stationary motor of 2 horsepower or less.
4. Switch terminal screws or connectors shall be designed to accommodate No. 10 solid conductor.

2.03 RECEPTACLES

A. Acceptable manufacturers
1. Arrow-Hart
2. Hubbell
3. General Electric
4. Leviton
5. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in Section 260000 and Division 01 for substitution requirement.

B. Material
1. Hospital grade receptacles shall be installed in corridors; Arrow-Hart 8200 Series.
2. Dedicated circuit and convenience duplex receptacles shall be rated 20 amperes, 125 volt AC; Arrow-Hart 5362 Series.
3. GFCI receptacles shall be rated 20 amperes, 125 volt with integral ground fault current interrupter; Arrow-Hart GF5342 Series.
4. Receptacles within 6’-0” of sink or wet area shall be GFI type.
5. All receptacles in restrooms, outdoors, and within 6’ of a sink shall be GFI type.
6. Circuit breakers serving vending machines, and EWCs shall be GFI (do not install GFI device at EWCs and vending machines).
7. Specific-use receptacles shall have volts, amps, poles and NEMA configuration as noted on drawings.
8. Heavy-duty lock-blade receptacles shall be NEMA WD5 heavy-duty specification grade.
9. Provide combination receptacle/USB outlets as shown and detailed.
10. Weatherproof receptacles as specified shall be mounted in a cast steel box with gasketed, weatherproof device plate as specified. Provide cast metal in-use cover where exposed to rain.

2.04 WALL PLATES

A. Acceptable manufacturers
1. Arrow-Hart
2. Hubbell
3. General Electric
4. Leviton
5. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in Section 260000 and Division 01 for substitution requirement.

B. Material

1. Wall plates shall be 316 or 302 stainless steel with cutouts as required for devices indicated on drawings, unless otherwise noted.
2. Where switches or outlets are shown adjacent to each other, they shall be ganged with partitions between different type services and covered by a single custom wall plate.
3. Exposed boxes:
    a. Dry interior spaces: Use cast metal plates with cast metal box. Use heavy cadmium-plated sheet steel plates with steel boxes and copper-free aluminum with aluminum boxes. All screws shall be stainless steel. Edges of plates must be flush with edges of boxes.
    b. Other locations: Use weatherproof devices plates. Provide cast metal plates with gasketed spring door
4. Jumbo plates are not permitted.
5. Weatherproof cover plate shall be gasketed cast aluminum or feraloy (by Crouse-Hinds) with hinged gasketed device covers (cast metal in-use cover where exposed to rain).

2.05 CUSTOM ENGRAVED COVER PLATES

A. In all areas, provide custom engraved cover plate in accordance with Section 260553, Electrical Identification, on all receptacles, switches, and low voltage lighting control stations indicating panelboard and circuit number with 3/16-inch black letters/numbers.

PART 3 EXECUTION

3.01 INSPECTION

A. Installer must examine the areas and conditions under which wiring devices are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Inspect devices for physical damage. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 DEVICE COORDINATION

A. Where items of equipment are provided under other sections of this specification or by the Owner, provide a compatible receptacle and/or device plate for the cap or plug, and cord of the equipment.

3.03 INSTALLATION

A. General:
    1. Install wiring devices as indicated, in accordance with the applicable requirements of the latest release of NEC, NEMA, and ANSI.
    2. The approximate location of switches, power outlets, etc., is indicated on the drawings. These drawings, however, may not give complete and accurate information in regard to locations of such items. Determine exact locations by reference to the general building drawings and by actual measurements during construction of the building before rough-in, subject to the approval of the Constructor Inspector.

B. Wall Switches and Lighting Control Stations:
    1. Location:
        a. Install wall switches and lighting control stations in suitable outlet box centered at the height of 48-inches above finished floor, OFF position down.
        b. Where wainscot occurs at the 48" level, install device in the wall below the wainscot and as near the 48" level as possible to provide the most pleasing appearance, but in no case partially in the wainscot and partially in the wall.
        c. Where shown near doors, install devices not less than 2" and not more than 12" from door trim.
        d. Verify all door swings before rough-in and locate devices on strike side of door as finally installed.

2. Position:
    a. Wall switches: Install wall switches in a uniform position so the same direction of operation will open and close the circuits throughout the project, generally up or to the left for the ON position.

C. Receptacles:
1. Location:
    a. Install convenience outlets in suitable steel outlet boxes centered at the height of 18 inches above the finished floor, 6 inches above countertop or at the backsplash level, or as indicated on the drawings. Coordinate with equipment and architectural drawings.
    b. Install receptacles generally where indicated on drawings. The Owner's representative reserves the right to make any reasonable changes in receptacle locations without change in the contract sum.
    c. Install specific-use receptacles at heights shown on Drawings.
2. Position:
    a. Install receptacles vertically with ground pole on bottom. Install receptacles horizontally, where field condition does not allow vertical installation, with ground pole on left.
3. Feed through to non-GFCI receptacles is not permitted.

D. Plates:
1. Where cover plates do not completely conceal the rough openings for the devices, it shall be the responsibility of the Contractor to patch, paint, etc. around the opening to the satisfaction of the Owner's representative.
2. All devices and cover plates shall be plumb and parallel to adjacent surfaces or trim. Devices must be flush with the finished trim cover plates and plates must be tight to surfaces over which they are installed.
3. Where switches controlling devices that are out of sight, or where three or more switches are gang mounted, plates shall be labeled to identify items being controlled, or areas being lighted. Labeling shall be 3/16-inch Condensed Gothic and shall be filled with black enamel.

END OF SECTION

SECTION 26 28 13
FUSES, 600 VOLT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 WORK INCLUDED

A. Dual-element, current limiting Class R fuses for loads up to 600 volts, 0-600 Amps.

B. Time delay, current limiting Class L fuses for loads up to 600 volts, 601-6000 Amps.

1.03 REFERENCES

A. UL 248-12 - Standard For Safety For Low-Voltage Fuses-Part 12: Class R Fuses

B. UL 248-10 - Standard For Safety For Low-Voltage Fuses-Part 10: Class L Fuses

C. Where application of local codes, trade association standard or publications appears to be in conflict with the requirements of this Section, the Architect/Engineer shall be asked for an interpretation.

1.04 SUBMITTALS

A. Provide submittals in accordance with and in addition to Section 260000, Basic Electrical Requirements, and Division 01 for submittal requirement.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Store fuses in a clean and dry space and protected from weather.

PART 2 PRODUCTS

2.01 MATERIAL AND EQUIPMENT

A. Furnish fuses manufactured by Buss, or equal, in accordance with the following:
   1. Motors, 0 to 600 Amp:
      a. 250 volt - Buss LPN-RK, UL Class RK1.

B. Size fuses serving motor loads as specifically recommended by motor or equipment manufacturer or in the range of 150% to 175% of motor nameplate rating per NEC in accordance to the type of motor.

C. Interrupting Rating: 300,000 RMS Amps.

D. Maintenance Stock, Fuses:
   1. Furnish the following:
      a. Three spare fuses of each size and type for a spare set.
      b. Provide spare fuse cabinet and locate in main electrical room.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install fuses where indicated, in accordance with the manufacturer's written instructions, the applicable requirements of NEC, national and local codes, regulations, and requirements.

B. Provide quantity of spare fuses and fuse cabinet per the requirement of this Section at the location per drawing or the direction of Owner’s Representative, in addition to replace blown or defective fuses during installation, startup, system commissioning and acceptance.

END OF SECTION

SECTION 26 28 16
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Fusible switches.
   2. Nonfusible switches.
   3. Molded-case circuit breakers (MCCBs).
   4. Enclosures.

1.03 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.04 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
   1. Enclosure types and details for types other than NEMA 250, Type 1.
   2. Current and voltage ratings.
   3. Short-circuit current ratings (interrupting and withstand, as appropriate).
   4. Include evidence of NRTL listing for series rating of installed devices.
   5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
   6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Field quality-control reports.
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.05 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.06 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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
   2. Fuse Pullers: Two for each size and type.

PART 2 PRODUCTS

2.01 FUSIBLE AND NON-FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Square D
   2. Eaton
   3. Siemens

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper conductors.
   3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
   4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
   5. Hookstick Handle: Allows use of a hookstick to operate the handle.
   6. Lugs: Mechanical type, suitable for number, size, and conductor material.
   7. Service-Rated Switches: Labeled for use as service equipment.
   8. Accessory Control Power Voltage: As required.

2.02 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Square D
   2. Eaton
   3. Siemens

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: For frame sizes 250 amp and below, inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits and adjustable magnetic trip setting.

D. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
   1. 400 amp frame and above.
   2. Instantaneous trip.
   3. Long- and short-time pickup levels.
   4. Long- and short-time time adjustments.

E. Current-Limiting Circuit Breakers: Frame sizes 600 amp and below.

F. Features and Accessories:
   1. Standard frame sizes, trip ratings, and number of poles.

2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
4. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

2.03 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
   1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
   2. Outdoor Locations: NEMA 250, Type 3R.
   3. Kitchen and Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
   4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
   5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
   6. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7 or Type 9.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

3.02 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:
   1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

B. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.03 ADJUSTING

A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study". Provide mission critical breakers or breakers with additional trip features as required for code required coordination.

END OF SECTION

SECTION 26 29 23
INSTALLATION OF VARIABLE FREQUENCY DRIVES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

A. Install variable frequency drives furnished under Section 232923, Variable Frequency Drives. Refer to 232923 for additional information.

1.03 RELATED SECTIONS

A. Section 232923 - Variable Frequency Drives

B. Section 230548 - Vibration Isolation

C. Section 230923 - Direct Digital Control Systems

D. Section 230993 - Sequence of Operation

E. Section 260519 - Cable, Wire and Connectors, 600 Volt

F. Section 260533 - Raceways, Conduits and Boxes

1.04 REFERENCES

A. NFPA 70 - National Electrical Code

B. IEEE - 112B, 587 and 519

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 230000.

B. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.

C. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.06 SCHEDULES ON DRAWINGS

A. In general, all capacities of equipment and electrical characteristics are shown in schedules on the Drawings. Reference shall be made to the schedules for such information. The capacities shown are minimum capacities. Variations in the capacities of the scheduled equipment supplied under this contract will be permitted only with the written direction of the owner. All equipment shall be shipped to the job with not less than a prime coat of paint or as specified hereinafter. Where installation instructions are not included in these Specifications or on the Drawings, the manufacturer's instructions shall be followed.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01 INSTALLATION

A. Contractor shall provide unistrut mounting bracket for drives. Contractor shall reinforce the wall studs with bracing as required to adequately support the drive. Installation of the VFD shall allow for clearance in front of the drive as required by the latest revision of the National Electric Code for an electrical panel.

END OF SECTION

SECTION 26 41 00
LIGHTNING PROTECTION SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 WORK INCLUDED

A. Extension of lightning protection system to new rooftop mechanical equipment.

B. System design.

C. Air terminals, interconnecting conductors, and other system components and accessories.

D. Grounding and bonding for lightning protection.

E. System inspection and certification.

1.03 RELATED WORK

A. This Section shall be used in conjunction with the following other specifications and related Contract Documents to establish the total requirements for lightning protection systems.
   1. Section 260000 - Basic Electrical Requirements
   2. Section 260533 - Raceways, Conduit, and Boxes
   3. Section 260526 - Grounding

B. In the event of conflict involving requirements of lightning protection systems between this Section and any other Sections, the provisions of this Section shall govern.

1.04 APPLICABLE CODES AND STANDARDS

A. The materials and installation shall conform to the minimum requirements and latest revisions of the following codes, standards and regulations wherein they apply:
   1. NFPA 70 - National Electrical Code
   2. UL 96 - Lightning Protection Components
   3. UL 96A - Installation Requirements for Lightning Protection Systems
   4. NFPA 780 - Lightning Protection Systems
   5. LPI 175 - Standard of Practice for the Design - Installation - Inspection of Lightning Protection Systems

1.05 SYSTEM DESCRIPTION

A. Lightning Protection System: UL 96A Master Labeled system consisting of air terminals on roofs, roof mounted mechanical equipment, stacks, bonding of structure and other metal objects; grounding electrodes; and interconnecting conductors. Lightning protection systems shall be incorporated into the building system by the lightning protection contractor as required for a complete master labeled system.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in lightning protection equipment with minimum three years documented experience and member of the Lightning Protection Institute.

B. Installer: The Contractor for the work covered by this specification shall be recognized as being regularly engaged in the design and installation of lightning protection systems. The Contractor must have minimum three years documented experience and member of the Lightning Protection Institute (LPI). Installer shall be a certified LPI master installer of lightning protection systems.

1.07 COORDINATION

A. Coordinate the work of this Section with concrete, roofing and exterior and interior finish installations.

B. Coordinate all provisions for down conductors and system connections with all trades.

1.08 SUBMITTALS

A. Provide submittals for the following information in addition to and in accordance with Section 260000, Basic Electrical Requirements, and Division 01 for submittal requirement.
   1. Shop drawings showing layout of air terminals, grounding electrodes, and bonding connections to structure and other metal objects. Include terminal, electrode, and conductor sizes, and connection and termination details.
   2. Shop drawings shall include locations of conductors, roof penetrations, etc., and method of installing in/on existing building.
   3. Product data showing dimensions and materials of each component, and include indication of listing in accordance with UL 96.
   4. As Built Record Drawings: The Contractor shall maintain a master set of As Built Record Drawings that shows changes and any other deviations from the Base Drawings in accordance with Section 260000.

1.09 MASTER LABEL

A. The system design shall equal to or exceed the requirement of UL 96A for a Master “C” Label. Upon completion, the lightning protection systems shall be inspected by a representative of Underwriters Laboratories, Inc. The lightning protection systems must pass UL inspection and wear UL label.

1.10 WARRANTY

A. Provide a warranty for material and installation per Section 260000, Basic Electrical Requirements, unless a longer warranty period is required in specific product specifications.

PART 2 PRODUCTS

2.01 GENERAL

A. The system provided under this specification shall be the standard product of a manufacturer regularly engaged in the production of lightning protection systems and shall be the manufacturer’s latest approved design.

B. Materials used in connection of the installation of the lightning protection system shall be proved for lightning protection systems by UL. No combination of materials shall be used that form an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture. Where unusual conditions exist which would cause corrosion of conductors, conductors with protective coatings or oversized conductors shall be used.

C. Where a mechanical hazard is involved, conductor size shall be increased to compensate therefore, or suitable protection shall be provided. The conductors may be protected by covering them with molding or tubing made of nonmetallic material.

D. Aluminum materials may not be used except on roofs that utilize aluminum roofing components. When aluminum materials are used, provide all materials of aluminum composition to ensure compatibility, except down conductors and grounding.

2.02 CONDUCTORS

A. All conductors shall be stranded copper and of the grade ordinarily required for commercial electrical work generally designated as being 98 percent conductive when annealed. Aluminum conductors may only be used on roofs that are built of aluminum roofing components. Conductor minimum size shall be in compliance with NFPA 780.

2.03 AIR TERMINALS

A. Air terminals shall be copper or copper alloy or aluminum per UL 96. Class II air terminal shall be of solid construction. Air terminal minimum diameter shall be in compliance with NFPA 780.

2.04 CONNECTIONS

A. Connector fittings shall be corer or copper alloy or aluminum per UL 96 and compatible with material type used for air terminals and conductors.

B. All concealed connections shall be made with exothermic welded connections.

2.05 ROOF PENETRATIONS

A. Roof penetrations shall be accomplished with through-roof fittings specially designed for this purpose. Through-roof fittings shall utilize solid rods with appropriate hardware. Fittings shall incorporate a positive means for sealing around the rod.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work.

B. Verify that field measurements are as shown on the shop drawings.

C. Beginning of installation means installer accepts existing conditions.

3.02 PROTECTION OF SURROUNDING ELEMENTS

A. Protect elements surrounding work of this Section from damage or disfiguration.

B. All roof work shall be by roofing company holding existing roof system warranty. Include their cost in bid.

3.03 CONDUCTORS

A. Install in accordance with manufacturer's instructions. Conceal concealed conductors. Concealed conductors shall be installed in continuous insulating PVC raceways. Metallic raceways shall not be used.

B. PVC conduit shall not be installed in plenums. If PVC conduit has to be installed in plenum space, the PVC conduit shall have fire rated walls installed creating a chase space for the conduit.

C. No bend of a conductor shall form an angle beyond 90 degrees nor shall have a bend radius less than 8 inches per NFPA 780.

3.04 AIR TERMINALS

A. Air terminal height and support shall be in compliance with the requirement of NFPA 780.

B. Air terminals shall not be mounted such they have to be moved to perform maintenance on the equipment they protect.

3.05 ROOF CONNECTIONS

A. Make direct connections to lightning protection system with copper conductor for all roof mounted equipment, enclosures, mast, fan stacks and all metallic objects alike. Provide bonding jumpers across all equipment mounting isolators and ductwork isolators to provide a complete ground path.

B. All antennas shall be grounded.

3.06 ROOF ATTACHMENT AND PENETRATIONS

A. Roof penetration. Contractor shall inform Owner's representative, in advance, of any required roof penetrations and shall obtain approval. Wherever the system penetrates the roof, approved through-roof fittings or sleeves shall be furnished by the lightning protection contractor and installed by the roofing contractor. All patching masonry and structural work shall be furnished and installed by the general contractor.

B. All attachments to roofs must be in strict accordance with the roof manufacturer’s recommendations. The lightning protection contractor shall submit details of all roof attachment to the appropriate roof manufacturer for approval prior to installation. Once the lightning

protection system installation is complete, the lightning protection contractor shall engage the appropriate roof manufacturer to inspect all roof attachments on that manufacturer's roof. Subsequent to the inspection, the roof manufacturer shall furnish the Owner with a letter indicating that all lightning protection systems component roof attachment and penetration are satisfactory and such attachments and penetrations will not in any way to void or reduce the warranty on roof. Any fees for services or inspections provided by the roof manufacturer to accomplish the above related requirements shall be at the expense of the lightning protection contractor.

3.07 COVER-UP INSPECTION

A. Prior to cover-up of concealed components and connections, notify the Owner so that a cover-up inspection can be performed. Correct any deficiencies prior to concealment of components and connections.

3.08 INSPECTION AND MASTER LABEL

A. Upon completion, the lightning protection systems shall be inspected by the representative of the Owner.

B. Obtain the services of Underwriters Laboratories, Inc. to provide inspection and certification of the lightning protection systems. If the system does not pass UL inspection, the Contractor must make corrections to the system in order to pass inspection. Contractor shall furnish the Owner with appropriate approval certificate.

C. Obtain UL Master Label and attach to building at a location as directed by Owner.

3.09 CONFLICTS

A. In the event a conflict exists between this specification and any of the referenced standards, the requirements of referenced standards govern. Necessary variances or corrections shall be made at the expense of the lightning protection contractor in order to obtain UL Master Label.

END OF SECTION

SECTION 26 51 00
INTERIOR LIGHTING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 WORK INCLUDED

A. Interior lighting fixtures and accessories

B. Exit lights

C. LEDs

D. Drivers

E. Emergency lighting relays

1.03 REFERENCES

A. NEPA 101 - Code for Safety to Life from Fire in Buildings and Structures

B. NEMA WD1 - General-Purpose Wiring Devices

C. UL 844 - Electric Lighting Fixtures for Use in hazardous (classified) Locations

D. UL 924 - Emergency Lighting and Power Equipment

E. IESNA - Lighting Handbook

F. NEMA WD 1 - General Color Requirements for Wiring devices

G. NFPA 70 - National Electrical Code

H. IECC 2015 - International Energy Conservation Code

1.04 DESIGN CRITERIA

A. Lighting level design shall be per IESNA (Illuminating Engineering Society of North America) recommendation.

1.05 SUBMITTALS

A. Provide submittals in accordance with and in addition to Section 260000, Basic Electrical Requirements, and Division 1 for submittal requirement.

B. Submit manufacturer's data on interior lighting fixtures in booklet form, with separate sheet for each fixture, assembled by luminaire "type" in alphabetical order, with the proposed fixture and accessories clearly labeled.

C. Submit dimensioned drawings and performance data including complete photometric test data for each luminaire, candlepower distribution curves in two or more planes, candlepower chart zero to 90 degrees, lumen output zonal summary chart, average and maximum brightness data, and coefficients of utilization for zonal cavity calculations, spacing to mounting height ratio, efficiency and visual comfort probability. Also provide luminaire weights, mounting data, and accessory information for each luminaire type.

D. Submit point-by-point calculations for all interior spaces (two separate calculations).
   1. Normal + emergency
   2. Emergency

E. LEDs: Catalog cuts showing voltages, colors, approximate hours life, approximate initial lumens, and lumen maintenance curve.

F. Drivers: Catalog cuts showing type, wiring diagram, nominal watts, input voltage, starting current, input watts, sound rating, power factor and low temperature characteristics.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver lighting fixtures individually wrapped in factory-fabricated fiberboard type containers.

B. Handle lighting fixtures carefully to prevent breakage, denting and scoring the fixture finish. Do not install damaged lighting fixtures.

C. Store lighting fixtures in a clean, dry space and protected from the weather.

PART 2 PRODUCTS

2.01 GENERAL

A. Lighting fixtures and accessories shall comply with the design and function requirements of the project. Design characteristics shall be as noted in manufacturer's submittal data.

B. Provide lighting fixtures of the size, type and rating as scheduled, complete with, but not limited to LEDs, reflectors, drivers, and wiring.

2.02 INTERIOR LIGHTING FIXTURES

A. Lenses shall be UV stabilized, injection-molded, clear, 0.150- inch minimum thickness virgin acrylic. Provide a minimum of 8 hold-down lens retaining clips for troffers utilizing framed diffuser lenses.

B. Lighting fixture door frames shall be flush steel hinged and equipped with rotary-action cam latches.

C. Lighting fixture housing shall be minimum 22-gauge, cold-rolled steel with pre-punched knockouts and access plate for electrical connections. End plates shall be minimum 20-gauge with pre-punched hanger holes. Driver mounts shall be separated for heat dissipation.

D. Reflector Finishes:
   1. Painted Finishes: Provide electro-statically applied dry polyester white powder coat finish with minimum reflectance of 88 percent on all light reflecting surfaces.
   2. Specular/Semispecular Finishes: Provide Alzak-type anodized finish on aluminum louvers and reflectors as specified in Luminaire Schedule as shown on the drawings. Minimum reflectivity shall be:
      a. Specular: 80 percent
      b. Semi-specular: 75 percent

E. UL Listing:
   1. All Luminaries and components shall be UL tested, listed, and labeled.
   2. Luminaries installed in damp or wet locations shall be UL listed and labeled as suitable for damp or wet locations.
   3. Recessed luminaries installed in fire rated ceilings and using a fire rated protective cover shall be thermally protected for this application and shall be approved for the installation in a fire-rated ceiling.

F. Flat panel and recessed can lighting fixtures installed in hard ceilings shall have accessible remote driver.

2.03 LEDS

A. All LED luminaires shall be UL Listed and be furnished complete with LEDs and Power supplies at locations indicated on the drawings. Each fixture shall bear the UL Label, and shall comply with Code Requirements.

B. Luminaires shall meet the US Department of Energy’s Energy Star performance criteria.

C. LED luminaires shall be designed with heat sinking adequate such that the junction temperature of the LEDs in maintained to meet the rated life as published by the LED manufacturer. Luminaire manufacturer shall provide validation documentation. Heat sinking shall not become compromised with time, lack of maintenance, and/or vibration resistance so that the heat-sink does not become detached from the LED PCB.

D. The LED luminaires shall have a complete 5 year warranty from date of installation

E. The LED luminaires shall be UL, or ETL listed and be furnished complete with LEDs and power supplies.

F. LED power supplies shall operate LEDs within the current limit specification of the manufacturer

G. Shall operate from 60Hz or 50Hz input source and have input power factor above 90% and a minimum efficiency of 70-% at full rated load of the driver.

H. Shall have short circuit and overload protection.

I. Shall have a minimum starting temperature of 0°F and a maximum case temperature rating of at least 70°C.

J. Power supply output shall be regulated to +/-5% across published load range.

K. Shall have a Class A sound rating.

L. Shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47CFR part 15, non-consumer (Class A) for EMI/RFI.

M. Shall have a 5 year warranty from date of manufacturer against defects in material or workmanship, including a replacement, for operation at or below the maximum case temperature specification.

N. Manufacturer shall have a 15 year history of producing power supplies for the North American market.

O. Dimmable power supplies shall be controlled by a (DC 0-10V Device/AC forward-phase control device/AC reverse phase control device) and shall be capable of operating, flicker-free, from 100-1% dimming range.
   1. Dimmable power supplies shall allow the light output to be maintained at the lowest control setting (prior to off) without dropping out.
   2. Shall be compatible with lighting control systems procured on the project.

P. All LEDs shall have a color temperature as noted on drawings with CRI ≥80. Confirm color temperature at time of preparing submittals.

Q. L70 rated life shall be a minimum of 50,000 hours.

R. All LED modules, unless noted otherwise, shall be provided by the light fixture manufacturer and integral to the luminaire.

S. LED modules/arrays shall be replaceable in the field. If luminaires are still under warranty, the Owner shall be compensated for the labor to do replacement work or the manufacturer shall send a factory representative to the site to do the work.

T. Replacement modules should have the ability to be “tuned” to match the output of remaining adjacent luminaires in the event that some time has passed and there has been light loss.

PART 3 EXECUTION

3.01 INSPECTION

A. Prior to order of lighting fixture, check the building electrical system requirements, architectural finishes, and the type of ceilings that lighting fixture will be installed. Any discrepancies of compatibility pertaining trim, frames, color, mounting, driver, voltage and etc. shall be brought to the attention of A/E by written notice. Do not proceed with procurement until discrepancies are resolved in a satisfactory manner.

B. Installer shall examine the areas and conditions that light fixtures are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF LIGHTING FIXTURES

A. Install light fixtures in accordance with the manufacturer's written instructions, the applicable requirements of NEC, and national and local codes, standards, and regulations.

B. Install luminaries at locations as shown on the Drawings; install aligned, aimed, and leveled. Install fixtures in accordance with manufacturer's installation instructions complete with mounting accessories, trim and support materials. Fasten fixtures securely to structural support members of the building; solid pendant fixtures shall be plumb.

C. Coordinate with other crafts to avoid conflicts between luminaires, supports, fittings and mechanical equipment.

D. Surface Mounted Fixtures:
   1. Fixtures shall be supported from structure at four points near each corner of fixtures.

E. Recessed Fixtures:
   1. Handle lenses using only new clean white cotton or silk gloves. Do not touch lenses with bare hands. Leave luminaries clean and free of any visible dust, debris, or fingerprints with all LEDs operational at time of acceptance of work.
   2. All recessed fixtures shall be supported from building structure above ceiling with galvanized steel wire at not less than 4 points near corners of fixture. Size of wire shall be capable of supporting weight of fixtures.
   3. Recessed luminaries trims shall fit snugly to the mounting surface and shall not exhibit light leaks or gaps. Provide feed-through junction boxes or provide separate junction boxes. All components shall be accessible through the ceiling opening.
   4. Connect recessed luminaries to junction box with flexible steel conduit and fixture wire.

F. Lighting Fixtures Adjustment:
   1. Adjust to illuminate intended areas as directed.

G. Immediately before final observation, clean all fixtures, inside and out, including plastics and glassware, and adjust all trim to properly fit adjacent surface, replace broken or damaged parts, and test all fixtures for electrical as well as mechanical operation.

H. Protect installed fixtures from damage during the remainder of the construction period.

I. Upon completion of installation of interior lighting fixtures, and after circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

END OF SECTION