SPECIFICATIONS

PROJECT MANUAL
100% CONSTRUCTION DOCUMENTS

E.H. HEREFORD UNIVERSITY CENTER
NORTH ENTRY ADDITION & RENOVATION

UNIVERSITY OF TEXAS AT ARLINGTON
300 WEST 1ST STREET
ARLINGTON, TEXAS 76010

UNIVERSITY OF
TEXAS
ARLINGTON

JULY 9, 2019
BRW PROJECT NO. 218125.00

BROWN REYNOLDS WATFORD ARCHITECTS, INC.
3535 TRAVIS STREET, SUITE 250
DALLAS, TEXAS 75204
214-528-8704

UNIVERSITY OF
TEXAS
ARLINGTON

E.H. HEREFORD UNIVERSITY CENTER
NORTH ENTRY ADDITION & RENOVATION
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ARLINGTON, TEXAS 76010

PROJECT MANUAL
100% CONSTRUCTION DOCUMENTS
JULY 9, 2019
BRW PROJECT NO. 218125.00

UNIVERSITY OF TEXAS AT ARLINGTON — **OWNER**
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ARLINGTON, TEXAS 76019
(817) 272-2011

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ARLINGTON, TEXAS 76013
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JQ ENGINEERING — **STRUCTURAL ENGINEER**
100 GLASS STREET
DALLAS, TEXAS 75207
(214) 752-9098

BAIRD, HAMPTON & BROWN
6300 RIDGLEA PLACE, SUITE 700
FORT WORTH, TEXAS 76116
(817) 338-1277

MECHANICAL / PLUMBING ENGINEER

YAGGI ENGINEERING, INC.
5840 WEST I-20, SUITE 270
ARLINGTON, TEXAS 76017
(817) 483-2373

ELECTRICAL ENGINEER

COKER ENGINEERING, LLC
1540 KELLER PARKWAY, SUITE 108
KELLER, TEXAS 76248
(817) 739-8333

FIRE PROTECTION ENGINEER

SECTION 00 00 07 - SEALS PAGE

ARCHITECT AND CONSULTANTS SEALS PAGE

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Craig Reynolds, AIA, Principal
3535 Travis St., Suite 250
Dallas, Texas 75204
214 / 528-8704
214 / 528-8707 fax

CIVIL ENGINEER:
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Joyce P. Stanton, P.E.
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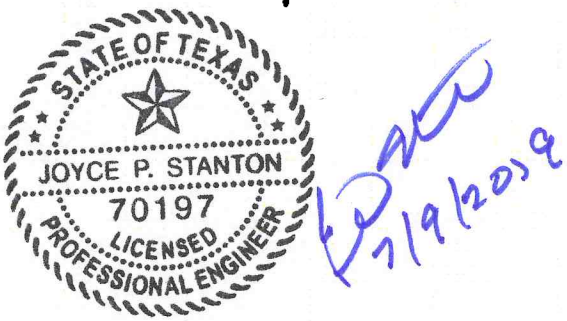

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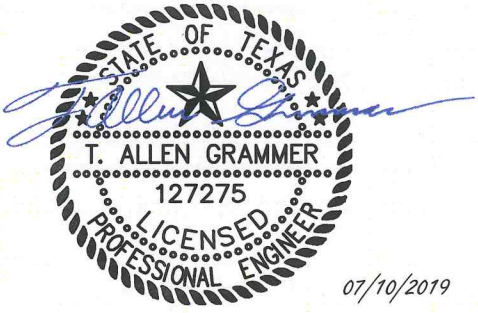

07/10/2019

ELECTRICAL ENGINEER:
Yaggi Engineering
Tim Yaggi, P.E.
5840 WEST I-20, SUITE 270
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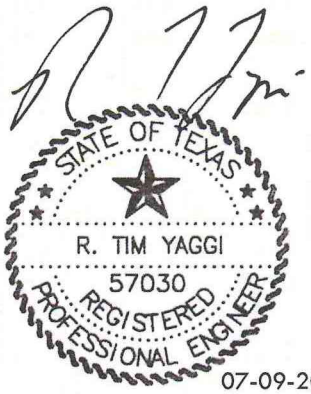

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UT ARLINGTON
UNIVERSITY CENTER NORTH ENTRY ADDITION & RENOVATION

REQUEST FOR COMPETITIVE SEALED PROPOSALS
SECTION 00 10 10

1. Sealed Proposals, will be received by:

   The University of Texas at Arlington
   Office of Facilities Management

   for general construction and other work of the:

   University Center North Entry Addition & Renovation

2. **PROPOSALS**:

   A. Proposals are solicited for Competitive Sealed Proposals for all General Construction Work including mechanical, plumbing and electrical work.

   B. All work shall be as shown on Drawings and as described in the Project Manual as prepared by BRW Architects, Inc., 3535 Travis Street, Suite 250, Dallas, TX 75204

   C. Proposals will be received as described in Section 1.5 of the Request for Proposal Document at

      The University of Texas at Arlington
      Office of Facilities Management
      1225 West Mitchell Street, Suite 205
      Arlington, Texas 76019

3. **DRAWINGS AND PROJECT MANUALS**:

   A. Refer to section 5 of the Request for Proposal Document.

   B. General Contractors, Mechanical Contractors and Electrical Contractors may review the Drawings and Project Manuals at the offices of BRW Architects, Inc., 3535 Travis Street, Suite 250, Dallas, TX 75204.

4. **PRE-SUBMITTAL CONFERENCE AND SITE VISIT**: See Section 1.11 of the Request for Proposal Document

5. **ENTIRE REQUEST FOR PROPOSAL:** Refer to the Request for Proposal document for all details regarding this proposal and expectations of the awarded respondent.

— END OF SECTION —

2013 UNIFORM GENERAL CONDITIONS
SECTION 00 10 20

1. Refer to the attached 50 page document for all details regarding this contract. The contract is included in project manual for reference only during the bidding phase and is subject to change as deemed necessary by UT Arlington.

— END OF SECTION —

UT ARLINGTON
UNIVERSITY CENTER NORTH ENTRY ADDITION & RENOVATION

SECTION 01 01 00
SUMMARY OF WORK

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Definitions
B. Summary of Work
C. Items Furnished by Owner, Installed by Contractor
D. References
E. Texas Accessibility Standards

1.2 DEFINITIONS

A. Whenever in these Contract Documents the following terms, or pronouns used in place of them, are used, the intent and meaning shall be interpreted as follows:

OWNER:	The University of Texas at Arlington Office of Facilities Management 1225 W. Mitchell, Suite 205 Arlington, Texas 76019
ARCHITECT:	BRW Architects Inc. 3535 Travis Street, Suite 250 Dallas, Texas 75204
MECHANICAL ENGINEERS:	Baird, Hampton & Brown, Inc. 6300 Ridglea Place – Suite 700 Fort Worth, Texas 76116
ELECTRICAL ENGINEER:	Yaggi Engineering, Inc. 5840 W. I-20, Suite 270 Arlington, Texas 76017
STRUCTURAL ENGINEER:	JQ Engineering 100 Glass Street Dallas, Texas 75207
CIVIL ENGINEER:	Di Sciullo-Terry, Stanton & Associates, Inc. 908 West Main Street Arlington, Texas 76013

1.3 SUMMARY OF WORK

A. In general, the work shall include all labor, materials, equipment and services necessary to complete the building construction, revisions and alterations to the existing building as indicated on the Drawings and described in the Project Manual.

B. Related Work Not a Part of This Contract:

1. Office furniture, tables, chairs, Artwork, etc.
2. Contractor shall coordinate with Owner's separate Contractor for the provision and installation of computer, audio, visual and similar IT devices.
3. Contractor shall coordinate with Owner's separate Asbestos Abatement Contractor for the removal of asbestos or other hazardous materials.
4. Irrigation and planting work shall be performed by owner's Grounds Department.

1.4 ITEMS FURNISHED BY OWNER, INSTALLED BY CONTRACTOR

A. Notify Architect ten (10) days prior to time work will be ready for installation of items, or portion of items. Architect will arrange time and location for Contractor to receive items at the site.

B. Contractor shall be responsible for items from time of receipt until date of Owner acceptance.

C. Contractor shall inspect items upon receipt and make written record of any existing damage, or defects. A copy of the written record shall be sent to the Architect.

D. Contractor shall dismantle and disconnect Owner furnished equipment and items, and reassemble and reconnect at new location as well as installing and connecting all new appliances as shown on the Drawings.

1.5 REFERENCES

A. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.

B. Some products, fabrications, and executions are specified throughout the following sections by reference to published specifications or standards. Listed below are typical references followed by the respective abbreviation. Additional references are identified in the Sections for which they apply.

1. American National Standards Institute, Inc. (ANSI).
2. American Society for Testing and Materials (ASTM).
3. Underwriters Laboratories (UL).
4. Factory Mutual (FM).
5. National Fire Protection Association (NFPA).
6. Commercial Standards (CS).
7. Americans with Disabilities Act (ADA).

1.6 TEXAS ACCESSIBILITY STANDARDS

A. The Contractor shall be responsible to construct all aspects of the project in accordance with the Texas Accessibility Standards (TAS) as administered by the Texas Department of Licensing and Regulation (TDLR).

B. The Contractor shall familiarize himself with the requirements and review the Contract Documents and notify the Architect of any discrepancies prior to commencing work on that particular item.

C. The Contractor will notify the Registered Accessibility Specialist (RAS) that reviewed the Drawings, at the appropriate time to allow for inspections of the project prior to Substantial Completion.

D. The Contractor shall notify the Architect and Owner forty-eight (48) hours in advance of inspection.

E. The Contractor shall remedy all deficiencies discovered during the inspection prior to Substantial or Final Completion, as deemed appropriate by the Architect.

1.7 SPECIFIC PRODUCTS REFERENCED

A. All products and materials listed in project manual or on drawings are used as descriptive only (not restrictive), and indicate type and quality desired. Bids on brands that are equivalent or exceed brand/model, please include with bid the manufacturer, brand or trade name, and complete descriptive literature.

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

NOT USED

— END OF SECTION —

SECTION 01 02 00
CONTRACT CONSIDERATIONS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Allowances
B. Schedule of Values
C. Application for Payment
D. Proposal Request (Changes)
E. Architect's Supplemental Instructions
F. Acceptance of Contract Documents and Requests for Information
G. Coordination
H. Coordination Drawings
I. Cutting and Patching
J. Web-Based Project Management
K. Construction site procedures for contractors

1.02 ALLOWANCES

A. Section 10 14 00 Signage - $30,000.00.

1.03 SCHEDULE OF VALUES

A. Schedule of Values shall be in accordance with the 2013 Uniform General Conditions for University of Texas System Building Contracts.

B. Submit a Schedule of Values to the Architect within twenty (20) calendar days after the date of the Owner-Contractor Agreement. Upon request of the Owner or Architect the Contractor shall furnish additional line item breakdown of the Schedule of Values.

C. Use Table of Contents of Project Manual as basis of format for listing categories of work. Provide a separate line item for material and labor for each category of work.

D. Include separate line items for the following:
   1. Site Mobilization
   2. Supervision / PM
   3. Contractor's Overhead and Profit
   4. Record Drawings
   5. Change Orders

1.04 APPLICATION FOR PAYMENT

A. At least ten (10) days before each progress payment falls due, the Contractor shall submit to the Architect and Owner a rough-draft, itemized Application for Payment based on the previously approved Schedule Of Values, of 90% of the value of labor and materials incorporated in the Work and of all stable materials suitably stored at the site to and including the last day of the proceeding month, less the aggregate total of all previous payments, provided the aggregate total of all monthly payments shall not exceed 90% of the contract price. Applications for Payment shall be supported by data substantiating the Contractor's right to payment as the Owner or the Architect may require.

B. Request for payment of stored materials shall be made only for material stored on site, accompanied by invoices showing the quantities of items with dollar amount that equals request of payment. Contractor may not request payment for materials which are stored off site.

C. Contractors shall use whole dollars and no cents for all bookkeeping between Owner and Contractor.

D. The full amount of retainage, plus monies for items to be completed or corrected will be withheld until Final Acceptance and Final Payment.

1.05 CHANGE PROCEDURE

A. Proposal Request: The Architect may issue a Proposal Request (PR) during the course of the Work. A Proposal Request is a description of a change in the Work under Contract such as additional work or revisions to work already completed, work not yet started or work in progress. The Proposal Request is issued to ascertain a mutually accepted lump sum cost adjustment for the Work described, whether add, deduct or no change.

B. The Contractor shall promptly submit to the Architect his completed Proposal, properly itemized and supported by sufficient substantiating data to permit evaluation.

C. The Contractor shall not proceed with the Work described in a Proposal Request until the Proposal has been evaluated, found to be fair and equitable by the Architect, presented to the Owner for approval and authorized in writing or issued in a Change Order. The Contractor, upon issuance of a Proposal Request, shall make every attempt to not install items of work that are affected by the Proposal and will notify the Architect of any and all items that cannot be postponed.

D. Unless agreed otherwise, two (2) weeks shall be allowed for evaluation by the Architect. If in the opinion of the Architect a Proposal is not found to be fair and equitable, the Contractor will reevaluate the cost and no additional cost or time extension will be considered for the time required for the reevaluation.

E. Two (2) weeks will be required to issue authorization to proceed after the Proposal Request is found to be fair and equitable. The Contractor's Proposal must be valid for the four (4) weeks stated above unless agreed otherwise.

1.06 ARCHITECT'S SUPPLEMENTAL INSTRUCTIONS

A. Architect's Supplemental Instructions are issued for work that is not described in sufficient detail or is generally stated but not specifically described to the extent required for the exact construction of such items. This information shall be issued to the Contractor(s) in the form of Architect's Supplemental Instructions (ASI) and shall be considered a minor change in the Work.

B. Should the Contractor consider Architect's Supplemental Instructions an item to be a change in the Contract Documents, he may notify the Architect in writing of the items in dispute and include the actual cost increase or decrease associated with each item.

C. Claims by the Contractor for additional cost, in response to an

D. Architect's Supplemental Instruction (ASI), must be received by the Architect within twenty (20) days after the posted date on the ASI or claims will not be considered. Proceeding with work described in an ASI shall constitute waiver of rights to claims.

1.07 ACCEPTANCE OF CONTRACT DOCUMENTS AND REQUESTS FOR INFORMATION

A. The Contractor shall review all the Contract Documents in detail during bidding and interpret them in order to submit his bid. Submission of a bid represents that the bidder accepts the Contract Documents as being sufficiently complete to illustrate the indicated result and he understands the documents and has included all items reasonably inferable as necessary for a complete project. Additional Drawings needed by the Contractor after signing of the Contract shall be the responsibility of the Contractor and shall be considered "Coordination Drawings." The "Coordination Drawings" for the purpose of this Contract will not be considered the practice of architecture or engineering. However, if the Contractor believes the "Coordination Drawings" represent the practice of architecture or engineering he shall hire and pay for registered architect or engineer to prepare the "Coordination Drawings.

B. A Request for Information will represent a Request for Interpretation.

C. If after the award of the contract the Contractor wants to confirm his interpretation of the contract documents is correct, he may use the following procedure to request information. Prior to submitting a written Request for Information (RFI), the Contractor shall call the Architect and review the issue. If it is mutually agreed that the issue needs to have a written confirmation, then the Contractor shall submit an RFI in writing as outlined below.

   All Requests for Information (RFIs) shall be submitted with Contractor's proposed solution attached for Architect's review and approval. The Contractor's proposed solution shall represent his interpretation of the Contract Documents and how he plans to accommodate the contract requirements within the contract amount and time.

   The RFI shall include:

   1. A copy of the portion of the Construction Drawing(s) or specifications involved with the RFI with the question noted on the drawing or specification using "PDF tools."
   2. The Contractor shall include his "Coordination Drawing" to illustrate the proposed solution.

D. The Contractor shall plan his work in advance so as to allow the Architect two (2) weeks to review the Contractor's RFI and proposed solution and not affect the contract amount or contract time.

E. All Requests for Information shall be submitted to the Architect in electronic form conforming to the following:

   1. Each RFI shall be numbered, per the web based Project management system provided by the Architect.
   2. The RFI log shall be reviewed during each progress meeting.

1.08 COORDINATION

A. Coordinate scheduling, submittals, and Work of the various Sections of specifications to assure efficient and orderly sequence of installation of interdependent construction elements.

B. Verify utility requirement characteristics of operating equipment are compatible with building utilities.

C. Coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable.

D. In finished areas, conceal pipes, ducts, and wiring within the construction.

1.09 COORDINATION DRAWINGS

A. GENERAL

The General Contractor shall be responsible for coordination of **all** Subcontractors' work such as civil, concrete, masonry, architectural, structural, mechanical, fire protection, electrical work, etc. The General Contractor shall prepare coordination drawings as required for the proper coordination of the work. The Contractor shall provide all labor and material required to accommodate the coordination of all trades. The Contractor shall utilize competent draftsmen to prepare the coordination drawings in a clear and fully legible manner acceptable to the Architect. The Contractor shall provide coordination drawings in addition to shop drawings.

B. LAYOUT & COMPOSITE DRAWINGS

1. LAYOUT DRAWINGS:

a. Mechanical, Plumbing, Electrical, and Fire Sprinkler Subcontractors, no later than thirty (30) days after award of contract, and sooner if possible, shall prepare and submit to General Contractor layout drawings prepared in AutoCAD and plotted at not less than 1/4" scale, showing all items listed in the following paragraph.

b. Items to be Shown: Ductwork, hydronic piping and plumbing, registers, grilles, diffusers, switch gear, electric panels, lights, routing of conduits, valves, dampers, fire sprinkler piping, access panels and similar features, as well as locations of other items requiring access for service and maintenance. Show locations and heights of structural members such as beams and joists. Show walls, columns, doors, cabinets and other major architectural and structural features as may be necessary. Note floor-to-floor heights and ceiling heights and height of bottom of structure. All items shall be drawn to scale.

c. Within five (5) days after receiving layout drawings the General Contractor shall send a CAD disk and reproducible vellum of the Mechanical layout drawings to the Fire Protection, Electrical Subcontractors and other Subcontractors that may be appropriate.

d. Furthermore, each Subcontractor shall show existing areas outside of the primary remodel area where pipes, conduits, etc. must be run through in order to accomplish the Work of this Project. These areas include areas above, below or adjacent to the primary area. In

cooperation with the General Contractor each Subcontractor shall research all existing elements and carefully plan out proposed routing outside the primary remodel area. The General Contractor shall coordinate the efforts of all Subcontractors and determine the best functional route balanced with the least disruption to the facility. The actual work shall be performed utilizing the “Work Plan Approval Request" and "Outage Request” system outlined in Section 01015.

Return modified CAD file or marked up reproducible to the General Contractor no later than ten (10) days after receipt.

2. COMPOSITE DRAWINGS:
   a. The General Contractor shall prepare a preliminary composite of all layout drawings. Incorporate all the information and routings provided by the Sub- contractors. These drawings are to be prepared in AutoCAD and plotted with different colors for various items.
   b. The General Contractor shall be responsible for coordinating Subcontractors' layout drawings in all areas including areas where no Mechanical work occurs. The General Contractor is to prepare all final composite drawings, large-scale details as well as cross and longitudinal sections, as required to fully delineate all conditions. Give particular attention to the locations, size and clearance dimensions of equipment items, shafts and similar features.
   c. All Affected Contractors shall attend a series of meetings scheduled and administered by the General Contractor for review of the various drafts of the preliminary composite drawings. All Subcontractors must attend the meetings in order to review and resolve any real or apparent interferences or conflicts. The Architect will be available on an hourly basis to attend the meetings, if requested, and his time paid for by the General Contractor. When mutually agreed upon among the General Contractor and Subcontractors, minor changes in duct, pipe or conduit routings that do not affect the intended function may be made in preparing the composite drawings as required to avoid space conflicts.
   d. Items may not be resized or exposed to view without obtaining the Architect's written approval. No changes in any wall or chase locations, ceiling heights, door swings or locations, window or other openings, or other features affecting the function or aesthetic effect of the building will be permitted without the Architect’s approval.
   e. General Contractor shall develop final composite drawings, after all conflicts or interferences are resolved, showing the agreed upon routing, layout and juxtaposition of all items listed under layout drawings.
   f. Each affected Subcontractor shall sign off on final composite drawings indicating each Subcontractor's awareness of, and agreement with, the indicated routings and layouts and their interrelationship with the adjoining or continuous work of the general construction. After the General Contractor and all affected Sub-contractors have signed off, the drawings will become the “Approved Composite Drawings”. Thereafter, no unauthorized deviations will be permitted to the “Approved Composite Drawings”. Any unauthorized work made without

knowledge or agreement of the General Contractor will be subject to removal and correction at no additional cost.

g. General Contractor is to provide and distribute a minimum of two (2) prints of the "Approved Composite Drawings" to each of the affected Subcontractors and Architect for reference and record purposes.
    1) Make similar distribution for revisions to composite drawings.
    2) Arrange and pay for CAD drafting and printing of composite drawings and revised composite drawings

3. General Contractor shall retain record copies of the final composite drawings as working reference. Compare all shop drawings with the composite drawings, and develop accordingly, prior to submittal to the Architect. Note any revision to the composite drawings that may become necessary during the progress of the work. Record neatly and accurately on record copies. Maintain up-to-date record copies of the composite drawings. Keep one (1) copy available at the site. Utilize the composite drawings and any subsequent changes for development of Project Record Drawings.
4. In all cases, submit drawings in ample time to avoid construction delay. Coordination drawings may lack complete data in certain instances pending receipt of shop drawings. In that instance, provide sufficient space for the affected items. Promptly insert final information on the composite when such data is received.
5. No extra compensation will be paid for relocating any duct, pipe, conduit, or other material installed without proper coordination between all affected contractors. If any Sub-contractor performs work that is in conflict with the approved composite drawings and necessitates additional work by other Subcontractors and/or the General Contractor, the conflict must be resolved and the additional work performed at no additional cost or time.
6. Show all changes in the scope of work due to revisions formally issued and approved by the Architect on the composite drawings.

1.10 CUTTING, PATCHING AND TOUCH-UP

A. Employ skilled and experienced installers to perform cutting and patching of new and existing work; restore work with new products.

B. Establish elevations, lines, and levels and certify that elevations and locations of the work conform with Contract Documents.

C. Execute fitting and adjustment of products to provide finished installation to comply with specified tolerances and finishes. Fit work tight to adjacent elements. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.

D. Execute cutting and demolition by methods that will prevent damage to other work and will provide proper surfaces to receive installation of repairs and new work.

E. Restore work that has been cut or removed; install new products to provide completed work in accordance with requirements of Contract Documents.

F. Refinish entire surfaces to match adjacent finishes to the nearest intersections. Refinish assemblies entirely.

1.11 WEB-BASED PROJECT MANAGEMENT

A. The web-based project management system shall be Submittal Exchange. The system is already in place and the contractor shall be required to utilize the system during the construction phase of project.

B. All construction correspondence is to be transmitted to the Architect in electronic (PDF) format using Submittal Exchange, including submittals, construction schedule, RFIs, ASIs, PCOs, Daily Reports, progress photos, Project Close-Out Documents, etc. Architect shall act as Project Administrator on Submittal Exchange.

C. The Electronic submittal process is not intended for color samples, color charts or physical materials samples, such items shall be delivered to Architect at progress meetings.

1.12 CONSTRUCTION SITE PROCEDURES FOR CONTRACTORS

A. The published request for proposal included the University of Texas at Arlington Environmental Health and Safety's Construction Site Procedures for Contractors Manual. The contractor shall comply with the most recent manual throughout the duration of the project.

B. The procedures include:

1. General Safety
2. Applicable regulations
3. Fire & Life Safety requirements
4. Procedures to follow while on the UT Arlington campus
5. Contractor requirements and responsibilities
6. Strom water requirements
7. Spill prevention, clean-up and disposal
8. Spill and complaint response program
9. Notification requirements and procedures
10. Contact information
11. SWPPP permit coverage requirements flowchart

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

NOT USED

— END OF SECTION —

UT ARLINGTON
UNIVERSITY CENTER NORTH ENTRY ADDITION & RENOVATION

SECTION 01 03 00
ALTERNATES

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Documentation of changes to the Contract Sum and/or Contract Time.

B. Owner-Contractor Agreement: Alternates accepted by Owner for incorporation into the work.

1.2 PROCEDURES

A. In the spaces provided on the Proposal Form, Bidders shall state the amounts to be added to or deducted from the Base Bid, if the described alternate bids are accepted. Alternate bids shall include profit, overhead, insurance, bond and similar related items.

B. Alternates will be exercised at the option of the Owner.

C. Modify or adjust affected adjacent work as necessary to completely and fully integrate all accepted alternates.

1.3 DESCRIPTION OF ALTERNATES

SEE SECTION 01 23 00

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

NOT USED

— END OF SECTION —

UT ARLINGTON
UNIVERSITY CENTER NORTH ENTRY ADDITION & RENOVATION

SECTION 01 03 90
MEETINGS DURING CONSTRUCTION

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Pre-Construction Conference
B. Progress Meetings
C. Pre-Installation of critical systems

1.2 PRE-CONSTRUCTION CONFERENCE

A. Prior to the start of the Work of this Contract, the Contractor, the Architect and the Owner's Representative will meet for the purpose of reviewing schedules, procedures, etc.

B. The location and date of the Pre-Construction Meeting will be scheduled after the Award of Contract to all affected parties.

C. Pre-Construction Conference Agenda shall include at least the following:

1. Introduction of Key Personnel.
2. Dates will be selected for meetings.
3. All required contract forms, bonds and insurance will be reviewed.
4. Schedules and Submittal Process will be reviewed.
5. Use of Site.
6. Review contract procedures.
7. Contractor questions.

1.3 PROGRESS MEETINGS

A. Biweekly Job Site Progress Meeting Agenda shall include at least the following:

1. Review and comment on previous meeting minutes.
2. Review Project Schedule: An up-to-date project schedule shall be submitted at each biweekly meeting.
3. Review any issues of weather days or anticipated delay days.
4. Review list of construction items to be observed before being covered or completed.
5. Review Pay Request: Submit rough-draft copies of the pay request for review unless notified otherwise by the Architect.
6. Review of Requests for Interpretation.
7. Review any status submittals.
8. Review any coordination issues.
9. Review Record Set of Drawings: Record set of drawings must be kept current with any changes to utilities, partitions, etc.
10. Confirm next meeting date and time.
11. Submit Daily Activity Reports in accordance with the contract requirements.

B. Except as directed otherwise, Contractor shall prepare minutes of the meetings in a format provided by the Architect and issue to the Architect, Owner and other designated persons, at least forty eight (48) hours prior to the next scheduled meeting.

1.4 PRE-INSTALLATION OF CRITICAL SYSTEM

A. Prior to the start of work the Contractor, Subcontractor, Owner's Representative, Architect and Engineer of such system shall meet to review any questions in regards to the submittal, sequence of work, or expectations of final product.

1. Masonry (Brick & Limestone)
2. Roofing System
3. Glazing and Storefront
4. Doors and Hardware
5. Steel Erection
6. Architectural Metal Panels
7. Air Handler Units
8. Air Distribution Boxes

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

— END OF SECTION —

SECTION 01 23 00 - ALTERNATES

PART 1 - GENERAL

1.01 SECTIONS INCLUDES

A. Identification of Alternates.

B. Description of Alternates

1.02 RELATED SECTIONS

A. Section 01 11 00 - Summary of Work.

B. Divisions 2 through 35: Specific sections could be affected by any Alternate.

1.03 IDENTIFICATION OF ALTERNATES

A. Alternates will be selected at the option of Owner. Alternates accepted by Owner for incorporation into the Work are identified in the Contract.

B. Coordinate related Work and modify surrounding Work as required to complete the Work, including changes required by each Alternate, designated in the Contract.

1.04 DESCRIPTION OF ALTERNATES

A. Alternate No. 1: Vehicular and pedestrian plaza: Site demolition and addition of approximately 30,000 SF of lighted Plaza with vehicular drop-off/fire lane and seating area associated with the new building entrance. Also included is approximately 38,000 SF of additional fire lane and parking area, with HC access, parking. Plaza includes two curved seating areas covered by steel trellis structures in front of bermed, landscaped lawns and adjacent to decomposed granite landscape patterns. Vehicular drop-off Plaza incorporates integrally stained, patterned concrete with concrete paver accents. Center of drop-off has planter area with stone bench border. Reference drawings for scope. Contractor shall provide demolition of Base Bid (Re: AS2.0) as a separate line item.

B. Alternate No. 2: Vehicular parking lot: Site demolition and addition of 137,000 SF of additional, lighted parking with a landscaped, central main drive aisle/fire lane. North end of parking to have bioswale, landscaped zone between parking lot and UTA Blvd. Sidewalks and HC access ramps are included. Reference drawings for scope. Contractor shall provide demolition of Bid Alternate No. 1 (Re: AS3.0) as a separate line item.

C. Alternate No. 3: Demolition of existing brick veneer and installation of limestone masonry veneer on approximately 10,000 SF of existing concrete masonry unit exterior walls. Provide waterproofing barrier, metal coping and flashing as required to prevent water penetration. Final quantity of work to be field verified.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION 01 23 00

SECTION 01 30 00
SUBMITTALS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Refer to Special Conditions, item 20, included in Request for Proposal section.

1.2 SECTION INCLUDES

A. Initial Submittals
B. Submittal Procedures
C. Schedule of Submittals
D. Reports, Warranties, Certificates and Manuals
E. Construction Schedule

1.3 INITIAL SUBMITTALS

A. The following information must be prepared and submitted to the Architect for approval within twenty (20) calendar days (unless noted otherwise) after date of Owner-Contractor Agreement. Failure to submit any of the following items to the Architect within the time allotted shall be grounds for withholding Contractor's Certificate for Payment.

1. List of Subcontractors and Suppliers: Include category of work, contact name, address and telephone number.
2. Construction Schedule: As described below.
3. Schedule of Values:
4. Cash Flow Schedule of anticipated amount of monthly estimates.
5. Schedule of Submittals.
6. Requests for Substitutions: Submit within thirty (30) days.
7. Schedule of Operation and Maintenance Data for Manuals: Refer to Section 01 70 00.

1.4 SUBMITTAL PROCEDURES FOR SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

A. The Architect will provide the General Contractor with AutoCAD electronic files of the Floor Plan, Ceiling Plan, Roof Plan, and Site Plan without the professional seals. The General Contractor must sign the Architect's "Electronic Data Transfer Agreement" before the electronic files will be provided. It will be the General Contractor's responsibility to distribute copies of the applicable files to the various subcontractors who require background plans for their Shop Drawing submittals.

B. Submit one (1) copy of Shop Drawings, product data and installation instructions in .pdf (electronic format) for the use of the Architect utilizing the web-based Project Management system as outlined in Section 01 02 00. All submittals, regardless of the source of origin, shall be submitted to the Architect via the General Contractor.

C. For each product specified or noted on the Drawings, submit two (2) samples for approval as applicable to the construction requirements.

D. Identify variations from Contract Documents and product or system limitations which may be detrimental to successful performance of the completed Work.

E. Apply Contractor's stamp, signed certifying that review for verification of product required, field dimensions, adjacent construction work and coordination of information, is in accordance with the requirements of the Work and Contract Documents.

F. Provide space for Contractor and Architect/Engineer review stamps.

G. Submittals shall be executed in sufficient time to allow at least three (3) weeks for each review by the Architect based on approved submittal schedule as outlined below.

H. Each product submittal shall be submitted with its own transmittal form, stating:

1. Product Name
2. Manufacturer
3. Numbered with the related Project Manual Specification Section for the submittal identity (Example: 07 09 00-1 for the first submittal for Firestopping and 07 09 00-2 for the second item submitted under the same Section, etc.).

I. Revise and resubmit submittals as required; identify all changes made since previous submittal. Revised submittals shall be submitted with their own transmittal form, stating:

1. Product Name
2. Manufacturer
3. Numbered with the original related Project Manual Specification Section for the submittal identity and a sequential alphabetic suffix (Example: 07 09 00-1a for a first revised submittal and 07 09 00-1b for a second revised submittal).

1.5 SCHEDULE OF SUBMITTALS

A. Provide list of all items requiring Shop Drawings, product data or samples.

B. Organize list by Specification Sections, and provide exact break down of phased portions of work.

C. Provide proposed date for each initial submittal. Allow sufficient time as may be required for resubmittals. The Contractor shall prepare a submittal schedule, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, and shall submit the schedule(s) for the Architect's approval. The Architect's approval shall not unreasonably be delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

1.6 REPORTS, WARRANTIES, CERTIFICATES AND MANUALS

A. Warranties: On all materials for a period of one (1) year and as required by various Specification Sections.

B. Special warranties in conjunction with mechanical equipment.

C. Test reports and certificates in conjunction with electrical equipment.

D. Jurisdiction Certificates:

1. Electrical Inspector's Certificate for Compliance with University requirements.
2. Plumbing inspector's Certificate for Compliance with University requirements.
3. Fire Department Inspector's Certificate for Occupancy.
4. Provide as required by the University a letter of certification from an independent, registered engineer verifying that the accepted grading plan has been accomplished.

E. Operations and Maintenance Manuals. Refer to Section 01 70 00.

F. Laboratory Test Reports.

1.7 CONSTRUCTION SCHEDULE

A. The Construction Schedule shall be prepared in the form of a bar graph identifying the first work day of each week and provide dates for completion of phases in the various categories of the work.

B. Revise and resubmit as required. Submit updated schedule with each Application for Payment.

C. The purpose of the Construction Schedule shall be to allow the Owner and Architect to evaluate the Contractor's performance and adherence to the schedule on a monthly basis along with the Contractor's Application for Payment.

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

NOT USED

— END OF SECTION —

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SUBMITTAL LIST

SECTION NUMBER	SECTION TITLE	Chk	SUBMITTALS
03 30 00	**Cast-In-Place Concrete**		Product Data
			Design Mixtures
			Leed Data and Design Mixtures
			Steel Reinforcement Shop Drawings
			Studrail Shop Drawings Steel Reinforcement Submittals for Information
			Formwork Shop Drawings
			Samples
			Welding Certificates
			Qualification Data
			Material Test Reports
			Material Certificates Manufacturer's Certificate of Max Chloride Ion Content in Admixtures
			Fly Ash
			Construction Joint Layout Floor Surface Flatness and Levelness Measurements
			Field Quality-Control Test Reports
			Minutes
03 35 00	**Concrete Floor Finishing**		Product Data
03 54 00	**Self-Leveling Underlayment**		Manufacturer's Data
04 05 03	**Masonry, Mortar and Grout**		Samples
04 20 00	**Unit Masonry**		Samples
			Shop Drawings
			Product Data
04 42 16	**Stone Cladding**		Samples
			Product Data
05 12 00	**Structural Steel**		Details and Schedules
			Details
			Embedment Drawings
			Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length and type of
			Indicate type, size and length of bolts, distinguishing between shop and field bolts.
			Identify pretensioned and sli-critical high-strength bolted connections
			Product Data
			Structural Analysis Data
			Connection calculations
			Welding Certificates

SUBMITTAL LIST

SECTION NUMBER	SECTION TITLE	Chk	SUBMITTALS
			Qualification data
			Mill test reports
			Source quality-control test reports
			Product data for LEED Credit MR 4.1
05 31 00	**Steel Deck**		Shop Drawings
			Product Data
			Product Certificates
			Manuf. Installation Instructions
			Welding Certificates
			Field Test and Inspection Reports
			Product Test Reports
			ICBO Research/Evaluation Reports
			Deck Units shall be classified by Underwriter's Laboratory, Inc. and labeled and marked as required by UL indicating testing & inspection
05 40 00	**Cold Formed Metal Framing**		Shop Drawings
5 50 00	**Metal Fabrications**		Shop Drawings
			Product Data
6 10 00	**Rough Carpentry**		Shop Drawings
06 25 00	**Finish Carpentry and Millwork**		Shop Drawings
			Samples
			Product Data
			Recommendations
			Labeled keys for millwork locks
6 61 16	**Solid Surfacing Fabrications**		Shop Drawings
			Samples
			Product Data
			Recommendations
			Fabricator and Installer Certifications
7 09 00	**Firestopping**		Product Data
07 11 00	**Dampproofing**		Samples
			Manufacturer's Data
07 13 00	**Membrane Waterproofing**		Samples
			Manufacturer's Data
07 18 00	**Fiberglass Planter Liner**		Product Data
07 19 00	**Water Repellents**		Manufacturer's Data
			Applicator Qualifications
07 21 00	**Thermal Insulation**		Product Data

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SUBMITTAL LIST

SECTION NUMBER	SECTION TITLE	Chk	SUBMITTALS
07 21 12	**Plastic Sheet Air Barrier**		Manufacturer's Data
07 27 00	**Air Barrier**		Manufacturer's Data
07 42 13	**Metal Wall Panels**		Product Data
			Maintenance Data
			Samples
			Shop Drawings
07 42 43	**Composite Wall Panels**		Shop Drawings
			Samples
			Manufacturer's Literature
			Affidavit
			Manufacturer's Maintenance Recommendations
07 51 15	**Modification to Existing Roof**		Mfr. Specs, Instructions and Details
			Applicator's Certificate
			Shop Drawings
			Mfr. Maintenance Instr. & Owner's Guide
07 52 00	**Modified Bitumen Sheet Roofing**		Product Data
			Roof System Certificate
			Applicator Certificate
			Mfr. Maintenance Instr. & Owner's Guide
			Samples
			Shop Drawings
07 62 00	**Sheet Metal Flashing and Trim**		Shop Drawings
			Color Samples
07 81 00	**Applied Fireproofing**		Manufacturer's Data
07 90 00	**Joint Sealers**		Product Data
			Sealant Color Samples
			Mfr. Maintenance Recommendations
07 95 00	**Expansion Control**		Product Data and Available Colors
			Shop Drawings
08 12 14	**Steel Doors and Frames**		Shop Drawings
			Product Data
8/14/2016	**Flush Wood Doors**		Shop Drawings
			Samples and Color Charts
			Samples: Each wood species & Finish
08 31 13	**Access Doors and Frames**		Product Data

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SUBMITTAL LIST

SECTION NUMBER	SECTION TITLE	Chk	SUBMITTALS
			Shop Drawings :
08 41 13	**Aluminum Entrances and Storefronts**		Shop Drawings
			Samples
08 44 23	**Point Support Fittings**		Product Data
			Shop Drawings
			Manufacturer's Qualification Statement
			Test Reports
			Manufacturer's Instructions
08 51 00	**Metal Windows**		Shop Drawings
08 71 00	**Door Hardware**		Finished Hardware Schedule
			Cut Sheet for each Hardware Item
			Samples, if requested
			Templates
			Wiring diagrams for electrical hardware
			Mfr. catalogs and data brochures
			Mfr. template numbers for each item on Hardware Schedule
			Final Approved Hardware Schedule to other Contractors and Subs
			Lever design or finish sample
			ADA and ANSI Compliance Letter
			Mfr. Maintenance Recommendations
08 80 00	**Glazing**		Product Data
			Samples
08 91 00	**Louvers**		Shop Drawings
			Product Data
			Samples
09 21 16	**Gypsum Board Assemblies**		Manufacturer's Data
			Samples
			Layout of gypsum board wall control joints
09 30 00	**Tiling**		Product Data
			Color Samples for Tile and Grout
			Maintenance Instructions
09 51 15	**Acoustical Panel Ceilings**		Product Data
			Shop Drawings
			Samples
			One (1) 1'-0" long sample of suspension system, including main runner, cross tees and wall molding

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SUBMITTAL LIST

SECTION NUMBER	SECTION TITLE	Chk	SUBMITTALS
			Mfr. Maintenance Recommendations
09 54 46	**Fabric Wrapped Ceiling Panels**		Product Data
			Shop Drawings
			Samples
			Certified Test Reports
09 65 00	**Resilient Flooring**		Samples
			Product Data
			Mfr. Primer & Adhesive Certifications
			Mfr. Maintenance Recommendations
09 68 13	**Tile Carpeting**		Square yardage amount, including overage and waste, required for carpet installation, per Suite for each carpet type. Submit within 48 hours after bid opening
			1st Submittal: Samples of available colors and patterns
			2nd Submittal: Final Approval Samples
			Mfr. Maintenance Recommendations
			Product Data: Carpet Constr. & Install.
			Product Data: Adhesive
			Shop Drawings
			Flammability and Flame Spread Compliance Certificate
09 90 00	**Painting and Coating**		Product Data
			Paint Color Samples
			Texture Samples
			Mock-up: 50 SF Painted Wall
			Mfr. Maintenance Recommendations
09 96 00	**High Performance Coatings**		Samples
			Product Data
			City Code Compliance Certificate
10 00 00	**Miscellaneous Specialties**		Shop Drawings
			Product Data
			Operating and Maintenance Instructions
10 11 00	**Visual Display Surfaces**		Shop Drawings
			Product Data
			Samples
			Operation and Maintenance
10 14 00	**Signage**		Shop Drawings and Brochures
10 21 14	**Plastic Toilet Compartments**		Shop Drawings
			Samples

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SUBMITTAL LIST

SECTION NUMBER	SECTION TITLE	Chk	SUBMITTALS
			Written Warranty on all Components
10 22 26	**Operable Glass Wall System**		Shop Drawings
			Product Data
			Samples
			Operation and Maintenance
10 28 00	**Toilet, Bath and Laundry Accessories**		Product Data
			Samples
			Mfr. Maintenance Recommendations
10 51 13	**Metal Lockers**		Shop Drawings
			Samples
11 14 43	**Security System**		Shop Drawings and Brochures
11 31 00	**Residential Appliances**		Shop Drawings
			Product Data
12 21 13	**Horizontal Louver Blinds**		Product Data
			Samples
			Submit full range of manufacturer's actual standard color samples
12 48 13	**Entrance Floor Mats**		Shop Drawings
			Data
			Samples
22 00 10	**Basic Plumbing Requirements**		Shop Drawings where required
22 05 29	**Plumbing Supports and Anchors**		Product Data
			Shop Drawings
			Maintenance Data
22 05 53	**Plumbing Identification**		Product Data
			Samples
			Schedules
			Maintenance Data
22 07 16	**Plumbing Piping Insulation**		Product Data
			Maintenance Data
			Samples
22 10 00	**Plumbing Piping**		Product Data
			Shop Drawings and Piping Layout
			Test, Flushing & Disinfection Certificates
22 10 01	**Plumbing Specialties**		Product Data
22 11 19	**Piping Specialties**		Product Data
			Shop Drawings

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SUBMITTAL LIST

SECTION NUMBER	SECTION TITLE	Chk	SUBMITTALS
			Maintenance Data
22 40 01	**Plumbing Fixtures**		Product Data
23 00 10	**Basic Mechanical Requirements**		Coordination Dra wings
			Third Party Certification
23 05 19	**Meters and Gauges**		Product Data
			Maintenance Data
23 05 29	**Supports and Anchors**		Product Data
23 05 48	**Mechanical Vibration Control**		Product Data
			Shop Drawings
			Maintenance Data
23 05 53	**Mechanical Identification**		Product Data
			Schedules
			Maintenance Data
23 05 93	**Testing, Adjusting, and Balancing**		Firm and Super visor Certificates
			Balancing Report
23 07 13	**HVAC Duct Insulation**		Product Data
			Maintenance Data
			Samples
23 07 19	**HVAC Piping Insulation**		Product Data
			Maintenance Data
23 09 23	**Building Control Systems (BCS)**		Shop Drawings
			Product Data
23 21 13.23	**Hydronic Piping**		Product Data
			Shop Drawings
			Piping System Test Certificates
			Record Drawings
			Maintenance Data
23 21 13.24	**Hydronic Specialties**		Product Data
			Shop Drawings
			Maintenance Data
23 31 13	**Metal Ductwork**		Product Data
			Shop Drawings
			Record Drawings
			Maintenance Data
23 31 13 .19	**Ductwork Accessories**		Product Data
			Shop Drawings
			Maintenance Data

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SUBMITTAL LIST

SECTION NUMBER	SECTION TITLE	Chk	SUBMITTALS	
23 34 00	**Fans**		Product Data	
			Shop Drawings	
			Wiring Diagrams	
			Maintenance Data	
23 37 13	**Air Outlets and Inlets**		Product Data	
			Samples	
			Shop Drawings	
			Maintenance Data	
23 41 00	**Air Cleaning**		Product Data	
			Shop Drawings	
			Samples	
			Wiring Diagrams	
			Maintenance Data	
23 73 13	**Air Handling Units**		Product Data	
			Shop Drawings	
			Wiring Diagrams	
			Maintenance Data	
26 0000	**Basic Electrical Requirements**		Inspection and Permit	Certificates
			Mfr. Catalog Cuts with each submittal	
			Line-by-line spec. review by equipment Mfr. & Contractor with any exceptions defined	
			Equipment layout drawing	
			Equipment and Materials List	
			As-Built Record Drawings	
26 0500	**Basic Electrical Materials and Methods**		Manufacturer's Data	Sheets & Literature
26 0518	**Electrical Connections to Equipment**		Product data	
26 0519	**Cable, Wire and Connectors, 600 Volt**		Manufacturer's Data	Sheets & Literature
			Qualification of Cable and Wire Mfr.	
26 0526	**Grounding**		Submittals in accordance with & addition to Section 26 00 00 and Division 01	
26 0529	**Securing and Supporting Methods**		Submittals in accordance with & addition to Section 26 00 00 and Division 01	
26 0533	**Raceway, Conduits and Boxes**		Shop Drawings - Comprehensive	
			Sealing/fire stopping materials and details	
			Layout of all penetrations prior to concrete floor pour	
			Shop Drawings of Conduits	
26 0553	**Electrical Identification**		Nameplate Identification Schedules	

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SUBMITTAL LIST

SECTION NUMBER	SECTION TITLE	Chk	SUBMITTALS
26 0573	**Overcurrent Protective Device Coor. Study**		Preliminary Coordination Study
			Final Coordination Study
26 0923	**Lighting Control Devices**		Product Data
			Shop Drawings
			Field-Quality test reports
			Operation and Maintenance Data
26 2416	**Panelboards**		Dimensioned Drawings
26 2726	**Wiring Devices**		Submittals in accordance with & addition to Section 26 00 00 and Division 01
26 2813	**Fuses, 600 Volt**		Submittals in accordance with & addition to Section 26 00 00 and Division 01
26 2816	**Disconnect Switches**		Submittals in accordance with & addition to Section 26 00 00 and Division 01
			Manufacturer's Product Data
			Dimensioned Drawings & Equip. Ratings
26 4100	**Lightning Protection Systems**		Shop Drawings
			Product Data
			As-Built Record Drawings
26 5100	**Interior and Exterior Lighting**		Manufacturer's Product Data
			Dimensioned Dwgs. & Performance data
			Detailed dwgs. of linear and suspended luminaires
			Detailed dwgs. of each cove & linear wall system configuration
			Catalog cuts of Lamps / LEDS
			Catalog cuts of ballasts and drivers
			Testing document for luminaires controlled by the lighting control system
			Site lighting pole data and catalog cuts
			Shop drawings for site lighting luminaires
			Catalog cuts and/or shop drawings showing controls data
			Compliance forms with engineer's data
			Foot-candle analysis - indoor and outdoor
			Sample of each luminaire
			Luminaire Mock-up

UT ARLINGTON **COMM. NO. 856**
UNIVERSITY CENTER NORTH ENTRY ADDITION & RENOVATION

SUBMITTAL LIST

SECTION NUMBER	SECTION TITLE	Chk	SUBMITTALS
31 63 29	**Drilled Piers**		Shop Drawings
			Pier Drilling Log
			Product Data
			Design Mixes
			Laboratory Test Reports
			Welding Certificates
			Qualification data
			Record Drawings
	Site Clearing		Record Drawings
	Subgrade and Fill for Site Work		Test reports for fill material
			Compaction tests
	Storm Utility Drainage Piping		Product Data
			Manufacturer's Installation Instructions
			Manufacturer's Certificate
			Project Record Documents
			Sustainable Submittals - Recycling Data
	Concrete Paving		Product data
			Sustainable Submittals - Recycling Data
			Shop Drawings
			Samples
			Design mixtures
			Manufacturer's Material Certificates

SECTION 01 41 00
TESTING LABORATORY SERVICES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. 2013 Uniform General Conditions for the University of Texas System Building Construction contracts.

1.2 SECTION INCLUDES

A. Cooperate with the Owner's selected testing agency and all others responsible for testing and inspecting the Work.

B. Provide such other testing and inspecting as are specified to be furnished by the Contractor in this Section and/or elsewhere in the Contract Documents.

C. Where no testing requirements are described, but the Owner decides that testing is required, the Owner may require such testing to be performed under current pertinent standards for testing.

1.3 PAYMENT FOR TESTING

A. Initial Testing: The Owner will select a pre-qualified independent testing laboratory and pay for all initial services of the testing laboratory as required by the Contract Documents and testing as the Owner deems necessary.

B. Retesting: When initial test indicate non-compliance with the Contract Documents, subsequent retesting occasioned by the non-compliance shall be performed by the same testing agency, refer to section 8.2 Testing of Contract.

1.4 LABORATORY DUTIES

A. Cooperate with Architect and Contractor; provide qualified personnel after due notice.

B. Perform specified inspections, sampling and testing:

1. Comply with specified standards.
2. Ascertain compliance of materials and work procedures with requirements of Contract Documents.
3. Provide test as required by the Building Official in order to comply with the special inspections portion of the Building Code.

C. Promptly notify Architect and Contractor of observed irregularities or deficiencies of work or products. Provide a monthly statement reflecting that all deficiencies that were identified to date have been re-tested and found acceptable. If all items have not been corrected, then the Laboratory shall list each unresolved item, its corresponding report number and report date.

D. Promptly submit written report of each test and inspection; one (1) copy each to Owner, Contractor, Engineers, and Architect. Each report shall include:

1. Date issued.
2. Project title and number.
3. Testing laboratory name, address and telephone number.
4. Name and signature of laboratory inspector.
5. Date and time of sampling or inspection.
6. Record of temperature and weather conditions.
7. Date of test.
8. Identification of product and specification section.
9. Location of sample or test in the Project.
10. Type of inspection or test.
11. Interpretation of test results, when requested by Architect.

E. Perform additional tests as required by Architect or the Owner.

F. Perform all work in accordance with the requirements of "Special Inspectors" as required by the International Building Code and the authority having jurisdiction.

1.5 LIMITATIONS OF AUTHORITY OF TESTING LABORATORY

A. Laboratory is not authorized to:

1. Release, revoke, alter or enlarge on requirements of Contract Documents.
2. Approve or accept any portion of the Work.
3. Perform any duties of the Contractor.
4. Stop the Work.

1.6 CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with laboratory personnel; provide access to Work.

B. Furnish copies of Products test reports as required.

C. Furnish incidental labor and facilities:

1. To provide access to Work to be tested.
2. To obtain and handle samples at the Project site.
3. To facilitate inspections and tests.
4. For storage and curing of test samples.

D. Notify Architect/Engineer and Laboratory in writing within twenty-four (24) hours prior to expected time for operations requiring inspection and testing services.

1.7 SCHEDULE OF INSPECTIONS AND TESTS

A. Section 31 05 14 - EARTHWORK

1. Tests and analysis of fill material will be performed in accordance with ANSI/ASTM D698.
2. Frequency of Tests: Spot field tests of backfilling densities shall be required at the rate of one (1) field density test per lift for each 5,000 sq. ft. of area, with a minimum of two (2) tests per section being worked. One (1) field density test per lift for each 150 linear ft. of trench, with a minimum of two (2) tests per lift.

B. Section 31 32 13 – LIME STABILIZED SUBGRADE

1. Sample Subgrade soils to determine soil type. Verify if lime is the proper stabilization additive once Subgrade elevation within proposed parking areas is established.

2. Field density tests performed at the rate of one (1) test per 5,000 sq. ft. of stabilized area.

C. Section 32 05 23 – CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS

1. Sample Cylinders: During the progress of the work, test cylinders shall be made from each different mix. Four (4) compression test cylinders will be taken during the pour for every pour of 100 cu. yd. or part thereof. One (1) tested at seven (7) days, two (2) tested at twenty-eight (28) days, and one (1) retained in reserve for further testing.
2. Make a slump test in accordance with ASTM C-143. Slump shall be a minimum of 4" to a maximum of 6" for each 60 cu. yd., or portion thereof, of concrete placed.
3. If tests of concrete do not meet the specified strength, coring shall be required. All coring shall be at the Contractor's expense.
4. Testing and coring shall be in compliance with ACI, Section 301.
5. Mix Design: The Contractor shall submit a concrete mix design for approval to the Independent Testing Lab, prior to placement of any concrete.

D. Section 03 20 00 - CONCRETE REINFORCEMENT

1. Prior to each concrete pour, inspect reinforcing sizes, bending of bars, quantities, spacing, placement, clearance of reinforcing from forms and tying in accordance with the Contract Documents and ACI 315.
2. Inspect support and securement of reinforcing.
3. Inspect condition of reinforcing.
4. Prior to each concrete pour, inspect positioning of steel inserts and assemblies, sizes and spacing of reinforcement and inspect fusion-welded anchors and shear connectors.

E. Section 03 30 00 - CAST-IN-PLACE CONCRETE

1. Sample Cylinders: During the progress of the work, test cylinders shall be made from each different mix. Four (4) compression test cylinders will be taken during the pour for every pour of 100 cu. yd. or part thereof. One (1) tested at seven (7) days, two (2) tested at twenty-eight (28) days, and one (1) retained in reserve for further testing.
2. Make a slump test in accordance with ASTM C-143. Slump shall be a minimum of 4" to a maximum of 6" for each 60 cu. yd., or portion thereof, of concrete placed.
3. Test for air content of all concrete permanently exposed to weather.
4. If tests of concrete do not meet the specified strength, coring shall be required. All coring shall be at the Contractor's expense.
5. Testing and coring shall be in compliance with ACI, Section 301.
6. Mix Design: The Contractor shall submit a concrete mix design for approval by the Testing Laboratory.
7. Provide full-time monitoring of cast-in-place concrete.

F. Section 04 05 03 – MASONRY, MORTARING, AND GROUTING

1. Inspect reinforced masonry work and materials at “Storm Resistant Corridors” in accordance with the requirements for masonry structures: ACI 530/ASCE 5/TMS 402 and 530.1/ASCE 6/TMS 602.
2. Test prism strength in accordance with ASTM C 140.
3. Inspect grout installation in accordance with ASTM C 476 and ASTM C 150.
4. Inspect installation of reinforcing steel.

G. Section 05 12 00- STRUCTURAL STEEL - Structural Metal Framing:

1. Site Inspection:
   a. Test 50% of all welded, shears, studs, and bolted connections, location as directed by Architect and Structural Engineer, in accordance with AWS Code D1.1-06.
   b. Visual inspection of all welds and bolted connections.

2. Shop Inspection:
   a. Provide inspection at shop of welds and bolted connections.

H. Section 05 31 23 - STEEL ROOF DECKING

1. Visual inspection to ensure the material and installation is in accordance with the specifications and shop drawings.

I. Section 05 31 13 - STEEL FLOOR DECKING

1. Visual inspection to ensure the material and installation is in accordance with the specifications and shop drawings.

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

NOT USED

— END OF SECTION —

SECTION 01 45 30
VISUAL MOCK-UP REQUIREMENTS

PART 1 – GENERAL

1.1 SUMMARY

A. This Section specifies full-size mock-up requirements of building components to verify material selections, demonstrate aesthetic effects and review construction and workmanship.

B. Approved mock-up shall establish the standard by which the Work will be judged.

C. Acceptance of mock-up does not constitute approval of deviations from the Contract Documents in mock-up, unless such deviations are specifically approved in writing by the Architect.

D. Retain mock-ups during construction and maintain in an undisturbed condition. Do not demolish, alter or remove mock-up until directed by the Architect.

E. Mock-up shall be used to demonstrate quality of materials, finish and workmanship as well as to show compliance with visual criteria.

F. Submit shop drawings prior to fabrication of visual mock-up showing plan, elevations and details of mock-up.

PART 2 – PRODUCTS

2.1 MATERIALS

A. As specified in individual Specification Sections.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Use the same workers to do work in conjunction with construction of the mock-up as covered by the work of their respective Contracts.

B. Provide mock-up complete with corners, splice joints, control joints, sealants, and complete finish with details identical to those proposed for use in the building and as indicated on the drawings.

C. Do not use special measures or techniques which are not representative of those to be used in the building. Finish the various components to show the maximum variation that will exist in the actual building construction between adjacent components.

D. Notify Architect when construction of mock-up begins and when major components are to be installed.

E. Complete the mock-up and obtain Architect's approval of each component of the mock-up prior to fabrication or purchase of products for the Project.

3.2 BUILDING EXTERIOR WALL

A. Fabricate and erect a visual mock-up of the typical exterior wall condition with one (1) outside corner returning to the window line.

1. Mock-up Size: As indicated on the drawings.

B. Provide structural steel framework for support of visual mock-up. Framework shall be designed by a registered professional or structural engineer licensed in the State where the Project is located.

C. Coordinate with Architect and Owner for location of mock-up on Project site. When directed, demolish mock-ups and remove from Project site.

D. Construct mock-up in such a manner that each type of exterior finishes will be demonstrated in a layered fashion from one side to the other. The purpose in the layers is to facilitate the review of the multiple activities that are required to accomplish the final finish.

E. Construct mock-up in phases so that proposed construction methodologies can be observed. Mock-up shall be completely constructed, just as if it were the finished exterior wall. Wall insulation and interior wall finishes are not required.

F. In addition to specifics in the respective Specification Sections, the mock-up will be reviewed by the Owner and the Architect for the following evaluation purposes:

1. Aesthetic: To review and verify selections made under submittals, as well as to show compliance with visual criteria. Acceptance criteria is for general and specific aesthetic qualities of construction and includes, but is not limited to, the following:
    a. Color, texture and blending of masonry units.
    b. Consistency of masonry mortar color.
    c. Tooling of masonry mortar joints.
    d. Color, texture and finishing of exterior insulation and finish system (EIFS).
    e. Tooling of sealants.
    f. Color consistency of aluminum window framing.
    g. Color and clarity of glass.
    h. Flatness and alignment of aluminum composite material panels.
2. Installation Execution: To review and verify quality of workmanship and compliance with Drawings, Specifications and submittals. Acceptance Criteria is for general and specific erection installation and application qualities of construction, and includes, but is not limited to, the following:
    a. Masonry bonding and mortar character.
    b. Brick cavity cleanliness.
    c. Brick cavity drainage function.
    d. Masonry anchor and ties integrity.
    e. Masonry flashing fabrication and embedment within the masonry.
    f. Assembly of various components of the exterior insulation and finish system (EIFS), including color, texture and finishing.
    g. Cold-formed metal framing fabrication and assemblage.
    h. Glazed aluminum wall system fabrication, anchorage/attachment, and installation quality.
    i. Glazing integrity.

j. Sealant profile consistency and bonding integrity.
k. Attachment of aluminum composite material panels.
l. Dimensional tolerances.

3.3 TYPICAL OFFICE MOCK-UP

A. Arrange for the construction of a typical office mock-up located in the building, per mutual agreement between Owner and Contractor.

1. Typical Office: At the first installation of a typical office, complete finishes, fixtures and accessories in one (1) office as a visual mock-up.

2. Typical Interview Room: At the first installation of a typical interview room, complete finishes, fixtures and accessories in one (1) interview room as a visual mock-up.

B. The materials trades Subcontractors shall do all work in conjunction with construction of the mock-up as covered by the work of their respective Contracts.

C. Typical room mock-up shall be complete with finishes, fixtures and details identical to those proposed for use in the Project. Do not use special measures or techniques which are not representative of those to be used in the finish work. Finish the various components to show the quality of material and construction that will exist in the actual construction.

D. Typical room mock-up shall be of adequate size to contain all samples and demonstrate quality of materials, finish and workmanship as well as to show compliance with visual criteria. Submit shop drawings to show layout of room prior to construction. Mock-up room shall be constructed as soon as sufficient structure is available to allow installation.

E. Materials or workmanship not approved shall be removed and replaced with acceptable products or workmanship. Fabrication, purchase or installation of materials for the building shall not begin until approved in the mock-up room. Owner's approval of samples will be required on all visual items prior to any Contractor's buy-out.

F. Materials installed in the room mock-up shall include an example of all furnished assemblies, hardware, equipment or accessories required for the Project and shall include, but may not be necessarily limited to, the following:

1. Lavatory countertop, complete with sealant, sink, accessories, trim, etc.
2. Flush wood veneer door.
3. Hollow metal door frame.
4. Door hardware.
5. Ceramic floor and wall material.
6. Vinyl wall covering(s).
7. Toilet compartment complete with partition, side wall, pilaster, door and hardware.
8. Toilet room accessories.
9. Water closet and trim.
10. Urinal and trim.
11. Lighting.
12. Electrical devises and accessories.
13. Access doors or panels.

— END OF SECTION —

SECTION 01 50 00
CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Security
B. Protection of Completed Work
C. Water Control
D. Use of Site
E. Temporary Controls
F. Project Identification and Signs
G. Field Offices and Sheds
H. Removal of Utilities
I. Fire Protection

1.2 SECURITY

A. Refer to Section 3.5 of Owner's Special Conditions.

1.3 PROTECTION OF COMPLETED WORK - DAMAGED ITEMS

A. Refer to Section 3.6 of Owner's Special Conditions.

1.4 WATER CONTROL

A. Provide pumps, piping, fittings, hose, trenching, sumps, etc., as required to control and remove surface and subsurface water from excavation and the site. Dispose of water in accordance with E.P.A. storm water management for construction activities. Refer to 31 10 80 for erosion control materials.

1.5 USE OF SITE

A. The Contractor will be responsible for protection of the Owner's property, including all adjacent structures, trees and shrubs.

B. Temporary toilets may be located in the construction area. Shall be by Contractor.

C. The extent of the construction site must be enclosed by a temporary fence. The fence shall have visual screening material from top to bottom. Provide gates as required. Location of construction fence shall be proposed by the Contractor and must be approved by the Owner. If shown on the Drawings the layout for all construction fence is diagrammatic. Exact routing is the responsibility of the Contractor. The Contractor may use whatever space is available within the fenced area, and not required for construction, for job offices, tool storage, vehicle parking, etc. Preserve existing trees.

1.6 TEMPORARY CONTROLS

A. Temporary Services and Utilities for Existing Building:

1. Owner to pay for all services and utilities required and all deposits therefore, including but not necessarily limited to water, sewer, gas and electrical service during the construction period.

B. Temporary Heat: Provide and maintain heat as required for the work during and throughout the entire period of construction to protect all work, materials and equipment against damage. The permanent heating system may be utilized for this purpose if the building is completely enclosed. However, if so utilized, the Contractor shall:

1. Obtain the written permission from the Owner and Mechanical Contractor for the use of heating equipment in building.
2. Pay for all charges in conjunction with repairs or replacement to heating equipment and devices during use of such equipment in order that heating equipment is turned over to the Owner in first class operation and equal to new condition.

C. Temporary Hoists: The General Contractor shall furnish, install and operate all temporary hoists as his needs may require and shall erect temporary stairs, ladders or scaffolding as his needs may require.

1.7 PROJECT IDENTIFICATION AND SIGNS

A. The Contractor shall provide one (1) Project Sign in a location approved by the Owner and Architect. The signs shall consist of a sheet of 4'-0" x 8'-0" x 3/4" exterior grade ply-wood turned horizontal and supported by two (2) 4" x 4" pressure-treated wood posts set in concrete 2'-0" minimum. The top of the sign to be at approximately 8'-0" above the ground. The sign and posts shall be painted white. Black lettering shall be professionally painted on the sign stating the following:

1. Name of Project.
2. Name of Contractor.
3. Name of Architect.
4. Any other information requested by the Owner including the building rendering.

The Contractor shall submit the sign layout for Owner and Architect approval prior to installation.

B. No other signs or advertising of any kind will be permitted without the approval of the Owner.

1.8 FIELD OFFICES AND SHEDS

A. Refer to Section 2.4 of Owner's Special Conditions.

B. Provide a suitable office with telephone and computer with high-speed internet access throughout construction. Keep an approved set of Drawings and Project Manual, including revisions, approved shop drawings, and samples on job at all times.

1.9 REMOVAL AND RELOCATION OF ABANDONED OR ACTIVE UTILITIES

A. Should active piping or conduit be encountered below grade within the construction site and be found at variance with the known conditions indicated by the Drawings and Specifications, relocate piping or conduit as directed by the Architect. Provide temporary support of active piping and conduit encountered in the excavations until permanent support or removal is accomplished. Cut off, and cap or plug abandoned lines at least 3' outside the building lines. In all cases, conform to the applicable requirements of the locality or governing agency.

1.10 FIRE PROTECTION

A. Refer to University of Texas Environmental Health and Safety Construction Site Procedures for Contractors Manual

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

NOT USED

— END OF SECTION —

UT ARLINGTON
UNIVERSITY CENTER NORTH ENTRY ADDITION & RENOVATION

SECTION 01 60 00
MATERIALS AND EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. 2013 Uniform General Conditions for University of Texas System Building Construction Contracts.

1.2 SECTION INCLUDES

A. Products
B. Transportation and Handling
C. Substitutions
D. Manufacturer's Directions
E. Color Schedule

1.3 PRODUCTS

A. All products and materials listed on drawings and in specifications are used as descriptive only (not restrictive), and indicate type and quality desired. Bids on brands that are equivilant, or exceed advertised specifications will be considered. If bidding other than specified brand/model, please include with bid the manufacturer, brand or trade name, and complete descriptive literature.

B. Products include new material, machinery, components, equipment, fixtures, and systems forming the Work, but do not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components specifically identified for reuse.

1.4 TRANSPORTATION AND HANDLING

A. Transport, handle, store and protect Products in accordance with manufacturer's instructions.

B. Materials shall be new, delivered and stored in authorized locations in unopened containers and in ample quantity to prevent delay. Ordering of materials shall be made well in advance so as not to hinder the progress of work. Grade marks, labels, etc. shall be kept readable.

1.5 SUBSTITUTIONS

A. The manufacture, materials, products and equipment described in the Construction Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution.

B. The details on the Drawings and the requirements of the Specifications shall be based on the first listed manufacturer, materials, products or equipment in the Contract Documents. All other products will be considered substitutions. If the Contractor desires to use any of

the other listed materials, products or equipment other than that listed first or if the Contractor substitutes a manufacturer, material, product or equipment, the Contractor alone shall be responsible for the correct function, operation and accommodation of the other manufacturer, materials, products or equipment into the spaces allotted on the Drawings.

C. Whenever, in any of the Contract Documents, any material, product or equipment is defined through the use of any federal association or other standard specification, the Contractor shall present satisfactory evidence of compliance with the particular specification for the material, product or equipment he proposes to furnish.

D. Request for Substitution Submittal Procedures:

1. No substitution will be considered unless one (1) copy is submitted on Request for Substitution form, which is at the end of this Section.
2. Request for Substitution during the bidding period:
   a. Substitutions shall be submitted to the Architect by the General Contractor at least ten (10) days prior to the date for receipt of bids.
   b. If the Architect approves a proposed substitution prior to receipt of bids, such approval will be set forth in an Addendum. Bidders shall not rely upon approvals made in any other manner.
3. Request for Substitution after award of contract:
   a. Substitutions shall be submitted to the Architect within at least thirty (30) calendar days after the award of contract. No substitutions will be considered after that time and the Contractor must provide the specified product.

1.6 MANUFACTURER'S DIRECTIONS

A. All manufactured articles, material, appliances and equipment shall be delivered, stored, applied, installed, connected, erected, used, cleaned, conditioned and placed in operation as directed by the respective manufacturers, insofar as these directions are applicable to this particular project and are not in conflict with superior requirements in the Specifications or requirements of applicable Building Codes.

1.7 COLOR SCHEDULE

A. A color schedule has been included in the construction documents. The Contractor shall submit three (3) samples of each product that a color has been specified and for each product shown to “match existing” for Architects approval. In addition, the Contractor shall submit the full range of available colors for any product that the color has not been specified for the Architect to make a selection.

B. Installation of such items shall not commence until the Architect has provided approval of each item.

C. The Contractor shall plan his submittals and flow of work to accommodate the color selection process above.

D. Contractor is to verify the availability of all products with a “selected” color prior to releasing the order for any material that has a “selected” color. The intent of this requirement is to prevent the shipment of a product in a “selected” color only to find out later that an adjacent product is not available in that “selected” color.

1.8 ELECTROLYTIC ACTION

A. Protect against electrolytic action between dissimilar metals by insulating all points of contact with suitable insulation material of minimum 1/8” thickness held securely in place.

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

NOT USED

REQUEST FOR SUBSTITUTION

PROJECT: **University Center North Entry Renovation & Addition**

DATE:

TO: BRW ARCHITECTS
3535 Travis Street, Ste. 250
Dallas, Texas 75204

FROM:

___Contractor ___Bidder ___Manufacturer

HEREBY REQUEST ACCEPTANCE OF THE FOLLOWING PRODUCT OR SYSTEMS AS A SUBSTITUTION IN ACCORD WITH PROVISIONS OF DIVISION ONE OF THE SPECIFICATIONS.

1. SPECIFIED PRODUCT OR SYSTEM:

Generic Description:_____

_____ Specification Section No.

_____Article(s) _____

Paragraph(s) _____

2. SUPPORTING DATA:

_____Product data for proposed substitution is attached (description of product, reference standards, performance and test data).

_____Sample is attached.

_____Sample will be sent if requested.

3. PRODUCT OR SYSTEM QUALITY COMPARISON:

	SPECIFIED PRODUCT	SUBSTITUTION
Name / Brand:	_____	_____
Catalog No.:	_____	_____
Manufacturer:	_____	_____
Vendor:	_____	_____
Significant Variations:	_____	_____
	_____	_____
	_____	_____

Maintenance Service Available: ____Yes ____No

Spare Parts Source: _____

4. PREVIOUS INSTALLATIONS: Attach list of local installations.

5. REASON FOR NOT GIVING PRIORITY TO SPECIFIED ITEMS:

_____

_____

6. EFFECT OF SUBSTITUTION:

Proposed substitution affects other parts of work: ____Yes ____No

(If yes, explain) _____

_____

Change Contract Time: ____Yes ____No Circle: Add / Deduct_____days

Substitution requires dimensional revision or redesign of structure or M & E Work:

____Yes (If yes, attach data) ____No

Credit to Owner for accepting substitution: $_____

Extra Cost to Owner for accepting substitution: $_____

7. STATEMENT OF CONFORMATION OF PROPOSED SUBSTITUTION TO CONTRACT REQUIREMENTS:

I / We have investigated the proposed substitution and

a. believe that it is equal or superior in all respects to specified product, except as stated above;
b. will provide the same warranty as specified for specified product;
c. have included complete cost data and implications of the substitution;
d. will pay redesign and special inspection costs caused by the use of this product;
e. will pay additional cost to other contractors caused by the substitution;
f. will coordinate and modify other parts of the work as may be needed, to make all parts of the work complete and functioning;
g. waive future claims for added cost to contract caused by the substitution.

Name and Title:_____ Date: _____
Print

Signature: _____

****

ARCHITECT'S REVIEW AND ACTION

____Resubmit Request for Substitution: ____Provide more information.

____Provide sample.

____Substitution is accepted.

____Substitution is accepted, with the following comments: _____

_____

____Substitution is **not** accepted:

_____

By:_____Date: _____
Printed Name Signature

_____

OWNER'S REVIEW AND ACTION

____ Substitution is accepted.

____ Substitution is accepted, with the following comments: _____

_____

____ Substitution is **not** accepted: _____

_____

By:_____Date: _____
Printed Name Signature

— END OF SECTION —

UT ARLINGTON
UNIVERSITY CENTER NORTH ENTRY ADDITION & RENOVATION

SECTION 01 61 00
HAZARDOUS MATERIALS

PART 1 – GENERAL

1.1 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.

1.2 SECTION INCLUDES

A. Documentation of exclusion of Hazardous Materials from the Work, including Asbestos Containing Materials (ACM's) and lead in conjunction with potable water system.

B. Related Sections:

1. Section 01 30 00 - Submittals
2. Section 01 60 00 - Materials and Equipment
3. Section 01 70 00 - Project Close-Out

1.3 REQUIREMENTS

A. As a condition of Final Payment, the Contractor shall submit to the Architect a notarized statement certifying that all materials used in the construction of this Project contain less than 0.10% by weight of asbestos and for which it can be demonstrated that, under reasonably foreseeable job site conditions, will not release asbestos fibers in excess of 0.1 fibers per cubic centimeter. Certification letter shall be dated, shall reference this specific Project, and shall be signed by not less than two (2) officers of the construction company. If the Architect has inadvertently specified an ACM not meeting this condition for use on this Work, it shall be the sole responsibility of the Contractor to discover and to bring to the attention of the Architect any such conflict in the intent of the Contract Documents.

1. The manner of resolution of such a conflict shall be handled as either a Field Order or as a Change Order, as proves appropriate and fair in the sole judgment of the Architect, whose opinion on this matter shall be final.
2. Accreditation by the State of Texas or by EPA shall be required of the inspector representing the Contractor on this matter.

B. The Contractor's statement required by this Section shall specifically warrant against the installation of any of the following during the course of Work.

1. Any friable ACM;
2. Any friable suspected ACM;
3. Any nonfriable ACM that is newly friable; and/or
4. Any thermal system insulation ACM.

C. The Contractor's statement required by this Section shall include the following information.

1. Name of accredited inspector.
2. Signature of accredited inspector.
3. Date of the inspection performed for this purpose.

D. Contractor shall submit to the Architect a letter addressed to the Owner certifying that all materials used in conjunction with potable water systems contain no lead. Certification letter shall be dated, shall reference this specific project, and shall be signed by not less than two (2) officers of the construction company.

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

NOT USED

— END OF SECTION —

SECTION 01 70 00
PROJECT CLOSEOUT

PART 1 – GENERAL

1.1 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.

1.2 SECTION INCLUDES

A. Representative Rooms
B. Substantial Completion
C. Cleaning
D. Record Documents
E. Operation and Maintenance Manuals
F. Warranties
G. Spare Parts and Maintenance Materials
H. Letters of Compliance

1.3 REPRESENTATIVE ROOMS

A. Prior to the Substantial Completion process, the Contractor shall prepare several designated rooms for the Architect's inspection. At each stage of completion, the Contractor shall notify the Architect ten (10) days prior to the date of each inspection.

B. After the rooms are clean and finished to a state of Substantial Completion, the Contractor shall prepare a comprehensive list of items to be completed or corrected for these rooms.

C. First Inspection: The Architect, upon receipt of the list, shall review the representative rooms. When, in the opinion of the Architect, the areas are Substantially Complete, the Architect will verify and amend the Contractor's list for the representative rooms.

D. Second Inspection: When listed items have been completed or corrected, the Architect shall, upon request, inspect the representative rooms for a second time. If the Architect approves the level of completion in these rooms, the remaining Work or portion thereof shall be cleaned and finished to the standard established by the second inspection.

1.4 SUBSTANTIAL COMPLETION

A. After the Work has been cleaned and finished to a state of Substantial Completion, the Contractor shall prepare a list of items to be completed or corrected. The Contractor shall give the Architect ten (10) days' written notice of the date the Work, or a portion of the Work, will be ready for each inspection.

B. First Inspection: Upon receipt of the list of items to be completed or corrected, if the Architect agrees that the level of completeness meets the standards established during the Representative Rooms review, the Architect will inspect the project for compliance with the Contract Documents. The Architect shall verify and amend the Contractor's list. The Architect will designate specific items on the list which must be completed or corrected before the Certificate of Substantial Completion will be issued.

C. If, in the Architect's opinion, the Contractor is not making the proper effort to complete or correct listed items, the Architect may report same to the Owner who will have the option of engaging other contractors to complete the work of the project. Such contractors shall be employed as stipulated in the General Conditions.

D. Second Inspection: When items have been corrected to meet the requirements of Substantial Completion, the Contractor shall notify the Architect to perform a second Substantial Completion inspection. If, in the opinion of the Owner and Architect, the work has been performed in compliance with the Contract Documents, and if documents defined in this Section and in the General Conditions and Supplementary Conditions have been prepared and received by the Owner, the Architect will issue the Certificate of Substantial Completion with the remaining items to be completed or corrected for final acceptance on an attached list.

E. Items to be Completed or Corrected: The list of items attached to the Certificate of Substantial Completion is a guideline of items to be completed or corrected for final acceptance. Items may be added to the list after the date of Substantial Completion as a guide of items to review at final inspection and as a record of the warranty date for those items.

F. Third Inspection: The inspection for final acceptance will made by the Architect only after he has received written notification from the Contractor that he has completed all items on the “list of items to be completed or corrected”. If the items are not all complete the Architect will charge the Owner for all additional trips to the site after the third inspection. The Contractor will reimburse the Owner for this additional cost and the Contract amount will be reduced accordingly by Change Order.

1.5 CLEANING

A. Execute cleaning prior to representative rooms reviews, substantial completion reviews and final inspections.

B. Clean all interior and exterior surfaces exposed to view. Vacuum carpeted and soft surfaces.

C. Clean debris from entire site, roofs, gutters, downspouts, and drainage systems.

D. Clean or replace filters of operating equipment.

E. Remove waste and surplus materials, rubbish, and construction facilities from the site.

F. The Contractor shall turn the work over in clean condition inside and outside. Clean-up shall include removal of smudges, marks, stains, fingerprints, soil, dirt, paint, dust, lint, unnecessary labels, discoloration’s and other foreign materials. Clean all finished surfaces inside and outside of building, such as (but not limited to) walks, drives, curbs, paving, fences, grounds, walls and screens. Slick surfaces shall be left with a clear shine. Remove all temporary facilities and job sign, including surface materials and temporary roads and walkways.

1.6 RECORD DOCUMENTS

A. The Contractor shall provide to the Owner through the Architect complete record documents at the completion of the project which includes the Drawings and Project Manual.

B. The Contractor shall acquire and pay for a set of the Drawings at the beginning of the project to be kept in a safe, neat environment at the site or in the Contractor's office. The Record Set of Drawings and Project Manual will be labeled with neat bold letters “Record Drawings” and “Record Project Manuals”.

C. During the course of performing the work, the Contractor shall neatly record all changes to the Contract Documents on the Record Drawings and Record Project Manual, including but not limited to:

1. All Addendums issued by the Architect.
2. All Change Orders approved by the Owner.
3. All supplementary instructions issued by the Architect in the form of Supplemental Instructions.
4. All answers issued by the Architect in response to "Requests for Interpretation" (RFIs) issued by Contractor that change any Drawing or Specification.
5. All changes by the Contractor of piping routings, duct layouts, electrical equipment placement, circuiting, etc. that deviate from locations shown on the Contract Documents shall be carefully recorded. The Contractor shall show and label all valves with the corresponding tag number.
6. All underground utility locations shall be reviewed with the Architect and consequently recorded on the record drawings.
7. Information regarding final material selections, signage and material colors shall be indicated on Record Drawings.
8. Color Schedule shall be added to the Record Documents.

D. Prior to application for payment each month, the Architect may review the “Record Drawing Prints” and “Project Manual” to verify that any changes during that pay period have been properly recorded. The Contractor shall keep a log on the cover sheet of the Drawings and a log in the front of the Project Manual indicating which Addendums, Change Orders, Supplemental Instructions, RFIs, etc. have been posted, the date they were posted, and by whom they were posted. Failure to record the changes that have occurred in that pay period will be grounds to withhold payment until they are recorded.

E. As part of Project Close-out, the Record Documents shall be submitted to the Architect for review and approval after Substantial Completion and prior to final payment.

F. As part of Project Closeout, the “Record Documents”, both the Record Drawings and the “Record Project Manual” shall be submitted to the Architect for review at Substantial Completion and prior to final payment. The Architect will compare the “Record Documents” to his own Record Set. The Architect will return the “Record Documents” to the Contractor who will promptly correct any deficiencies or discrepancies to the satisfaction of the Architect and replot the appropriate sheets. The Contractor will then submit to the Architect a PDF version on CD and a paper copy of the Record Drawings and the “Record Project Manual”.

G. The Contractor shall show a reasonable sum of money for “Record Documents” as a line item on his schedule of values.

1.7 WARRANTY AND OPERATION AND MAINTENANCE MANUALS

A. Furnish the Owner, through the Architect, two (2) copies of the following:

1. Operating instructions and maintenance recommendations for all work installed in the building, including that installed by General Contractor’s own forces and all work done by sub-contractors.

2. Warranty information for all work installed in the building, including that installed by General Contractor’s own forces and all work done by sub-contractors.

B. One copy of each shall be submitted to the Architect in advance for review. The Contractor shall make corrections required by the Architect and then submit the two (2) final copies of each. These final manuals shall be prepared and transmitted to the Architect for approval so they can be given to the Owner no less than ten (10) days prior to Substantial Completion.

C. Warranty and Operation and Maintenance Manuals shall be submitted in the following form and shall be neatly typewritten and complete.

1. General:

a. Series of 3-ring binders of the same size and color. They shall have a cover sheet with the name of the project, Contractor, and Architect. The cover shall also include the volume number and title. This information will be duplicated on the binding of the 3-ring binder.
b. Each binder will have a Table of Contents in the front. It will cover information contained in all binders.
c. Tabbed dividers will be provided between each section of information and shall be visible when project binder cover is opened. All information shall be organized by Specification Section Number with divider between each section. Information will be arranged in a neat, orderly fashion so it may be easily accessed when needed.
d. Any information submitted which is printed and distributed for multiple products shall clearly indicate product utilized in the project and any and all options provided.

D. Warranty Manual shall include:

1. Division 1 information shall include the following:

a. Project Directory.
b. List of sub-contractors and suppliers with address and phone number and trade or material they provided.
c. Copy of Certificate of Occupancy, inspection approvals from all authorities having jurisdiction and mechanical/electrical test reports. Copies of all inspection tags received over the course of the project shall be included.
d. Copy of any Letters that may be required by specific specification section.
e. Copy of Certificate of Substantial Completion and accompanying List of Items to be Corrected or Completed.
f. Any affidavits required by Contract Documents.
g. Copy of Texas Accessibility Standards Inspection Report.
h. Comprehensive Attic Stock Letter – from contractor listing all items of attic stock provided to the Owner in specification section number order.
i. Contractor's Warranty Letter.

2. Division 2 through 49.

a. Provide Warranty Letter from sub-contractors and any manufacturer's warranty information for products utilized on project.

E. Operation and Maintenance Manual will include:

1. Division 1 information shall include the following:
a. Project Directory
b. List of sub-contractors and suppliers with address and phone number and trade or material they provided.

2. Division 2 through 49:
   a. Manufacturer's Maintenance and Care instructions for each product utilized on project.
   b. Installation Instructions.
   c. Programming instructions.
   d. Sequence of Operation.
   e. Training letter and or recordings

F. The work covered by these manuals will not be inspected for Substantial Completion until Owner has received the manuals described above.

G. Once Final Copies of Warranty and Operation and Maintenance Manuals have been approved by Architect, Contractor shall provide one (1) copy of Operation and Maintenance Manual and one (1) copy of Warranty Manual on CD in electronic PDF format, including all information, in the same form and order approved by Architect

1.8 WARRANTIES

A. Warranties and Certificates: Prior to the final payment, Contractor and subcontractors shall forward to the Architect, copies of warranties and certificates as required by the Contract Documents.

B. The Contractor and each subcontractor shall furnish written warranties, covering their respective work or equipment for a minimum period of one (1) year from the date of acceptance, against defects of material or workmanship at no cost to the Owner. Some work may be specified to be covered under a longer period of warranty. All warranties shall be signed by the responsible Contractor and subcontractor.

C. Wherever defects occur within the time limit of the warranty, if such unsatisfactory condition is due to the use of materials or workmanship which are inferior, defective or not in accordance with the Contract, the Contractor, whenever notified, shall immediately:

   1. Place any such warranted work and/or materials in satisfactory condition in every particular.
   2. Make good any work or materials, or the equipment or contents of said structures or grounds, which are damaged in fulfilling any such warranty at no cost to the Owner, and to the satisfaction of the Architect.

D. Should the Contractor fail to proceed promptly with the terms of this warranty, the Owner may have such work performed as he may reasonably deem necessary to fulfill the warranty, charging the cost thereof against the Contractor.

1.9 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide Products, spare parts, maintenance and extra materials in quantities specified in individual specification Sections.

B. Prepare a list of these items and include in the Owner's Manual.

1.10 LETTERS OF COMPLIANCE

A. Provide letters as specified in the Project Manual.

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

NOT USED

— END OF SECTION —

SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:
   1. Demolition and removal of selected portions of a building or structure.
   2. Demolition and removal of selected site elements.
   3. Repair procedures for selective demolition operations.

B. Related Sections include the following:
   1. Division 1 Section - Summary for use of the premises and phasing requirements.
   2. Division 1 Section - Work Restrictions for restrictions on use of the premises due to Owner or tenant occupancy.
   3. Division 1 Section - Construction Progress Documentation for preconstruction photographs taken before selective demolition.
   4. Division 1 Section - Temporary Facilities and Controls for temporary construction and environmental-protection measures for selective demolition operations.
   5. Division 1 Section - Cutting and Patching for cutting and patching procedures for selective demolition operations.
   6. Division 22, 23 Sections for demolishing, cutting, patching, or relocating mechanical items.
   7. Division 26, 27, 28 Sections for demolishing, cutting, patching, or relocating electrical items.

1.03 DEFINITIONS

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

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

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

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

1.04 MATERIALS OWNERSHIP

A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.

B. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered during selective demolition remain Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Owner.

1.05 SUBMITTALLS

A. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

B. Proposed Dust-Control and Noise-Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.

C. Schedule of Selective Demolition Activities: Indicate the following:
   1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
   2. Interruption of utility services.
   3. Coordination for shutoff, capping, and continuation of utility services.
   4. Use of elevator and stairs.
   5. Locations of temporary partitions and means of egress.
   6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

D. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition

E. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.

F. Predemolition Photographs or Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Submit before Work begins.

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.

H. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

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

1.06 QUALITY ASSURANCE

A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

B. Professional Engineer Qualifications: Comply with Division 1 Section - Quality Requirements.

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

D. Standards: Comply with ANSI A10.6 and NFPA 241.

E. Predemolition Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to selective demolition including, but not limited to, the following:

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.

F. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.07 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
1. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.

D. Owner assumes no responsibility for condition of areas to be selectively demolished.
1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
2. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

E. Hazardous Materials: Hazardous materials are present in building to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
1. Hazardous material remediation is specified elsewhere in the Contract Documents.
2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.

F. Storage or sale of removed items or materials on-site will not be permitted.

G. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
1. Maintain fire-protection facilities in service during selective demolition operations.

1.08 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.01 REPAIR MATERIALS

A. Use repair materials identical to existing materials.
   1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
   2. Use materials whose installed performance equals or surpasses that of existing materials.

B. Comply with material and installation requirements specified in individual Specification Sections.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that utilities have been disconnected and capped.

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

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

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

E. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

F. Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.

G. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

H. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.

I. Survey of Existing Conditions: Record existing conditions by use of measured drawings preconstruction photographs and preconstruction videotapes.
   1. Comply with requirements specified in Division 01 Section "Photographic Documentation".
   2. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.
   3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.02 UTILITY SERVICES

A. Existing Utilities: Maintain services indicated to remain and protect them against damage during selective demolition operations.

B. Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.
   1. Provide at least 72 hours' notice to Owner if shutdown of service is required during changeover.

C. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished.
   1. Owner will arrange to shut off indicated utilities when requested by Contractor.
   2. Arrange to shut off indicated utilities with utility companies.
   3. If utility services are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary utilities that bypass area of selective demolition and that maintain continuity of service to other parts of building.
   4. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

D. Utility Requirements: Refer to Division 21 and 28 Sections for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.03 PREPARATION

A. Dangerous Materials: Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.

B. Pest Control: Employ a certified, licensed exterminator to treat building and to control rodents and vermin before and during selective demolition operations.

C. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
   1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
   2. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
   3. Protect existing site improvements, appurtenances, and landscaping to remain.
   4. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.

D. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
   1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
   2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
   3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
   4. Cover and protect furniture, furnishings, and equipment that have not been removed.
   5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 01 Section "Temporary Facilities and Controls".

E. Temporary Enclosures: Provide temporary enclosures for protection of existing building and construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
   1. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.

F. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.

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

3.04 POLLUTION CONTROLS

A. Dust Control: Use water mist, temporary enclosures, and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.
   1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
   2. Wet mop floors to eliminate trackable dirt and wipe down walls and doors of demolition enclosure. Vacuum carpeted areas.

B. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
   1. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

C. Cleaning: Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.05 SELECTIVE DEMOLITION

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
   1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
   2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
   3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
   4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
   5. Maintain adequate ventilation when using cutting torches.
   6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
   7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
   8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
   9. Dispose of demolished items and materials promptly.
   10. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.

11. Dispose of demolished items and materials promptly. Comply with requirements in Division 01 Section "Construction Waste Management and Disposal."

B. Existing Facilities: Comply with building manager's requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.

C. Reuse of Building Elements: Project has been designed to result in end-of-Project rates for reuse of building elements as follows. Do not demolish building elements beyond what is indicated on Drawings without Architect's approval.
   1. Building Structure and Shell: Maintain existing building structure (including structural floor and roof decking) and envelope (exterior skin and framing, excluding window assemblies and nonstructural roofing material) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.
   2. Nonshell Elements: Maintain existing interior nonstructural elements (interior walls, doors, floor coverings, and ceiling systems) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.
   3. Nonshell Elements: Maintain existing nonshell, nonstructural components (walls, flooring, and ceilings) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.

D. Removed and Salvaged Items: Comply with the following:
   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.

E. Removed and Reinstalled Items: Comply with the following:
   1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
   2. Pack or crate items after cleaning and repairing. Identify contents of containers.
   3. Protect items from damage during transport and storage.
   4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

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

G. Concrete: Demolish in small sections. Cut concrete to a depth of at least 3/4 inch at junctures with construction to remain, using power-driven saw. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete indicated for selective demolition. Neatly trim openings to dimensions indicated.

H. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

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

J. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI-WP and its Addendum.
   1. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.

2. Asbestos-containing flooring materials shall be removed in compliance with the RFCI recommended work practices, and OSHA, EPA and any state and local standards or requirements.

K. Roofing: Remove no more existing roofing than can be covered in one day by new roofing. Refer to applicable Division 7 Section for new roofing requirements.
   1. Remove existing roof membrane, flashings, copings, and roof accessories.
   2. Remove existing roofing system down to substrate.

L. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.06 PATCHING AND REPAIRS

A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.

B. Patching: Comply with Division 1 Section "Cutting and Patching."

C. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
   1. Completely fill holes and depressions in existing masonry walls that are to remain with an approved masonry patching material applied according to manufacturer's written recommendations.

D. Finishes: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

E. Floors and Walls: Where walls or partitions that are demolished 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 existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
   1. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
   2. Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.
   3. Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

F. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.07 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
   1. Do not allow demolished materials to accumulate on-site.
   2. Remove & transport debris in a manner that prevents spillage on adjacent surfaces and areas.
   3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
   4. Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

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

3.08 CLEANING

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

3.09 SELECTIVE DEMOLITION SCHEDULE

A. Existing Construction to Be Removed: Existing roofing deck, and insulation above existing vestibule. Existing slab, glazing, glazing system, exterior CMU wall, flooring, interior partition assemblies, ceiling assemblies, existing paving, and other construction as indicated.

B. Existing Items to Be Removed and Reinstalled: Salvage removed brick cladding to patch and repair brick cladding where disturbed by new construction.

C. Existing Items to Remain: Vestibule joists to remain as indicated.

END OF SECTION 02 41 19

SECTION 02 80 00 - HAZARDOUS MATERIAL ABATEMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SCOPE OF WORK

A. Provide all operations required in connection with the removal of asbestos containing materials in renovated areas, including the removal and proper disposal of all existing and generated trash from demolition and abatement, whether or not identified in the Asbestos Inspection Report described in Division 1 Section - Information Available to Bidders.

1.03 EXAMINATION OF SITE

A. Contractor shall visit and examine the building and site to ascertain the actual nature and scope of demolition work. Later claims for additional compensation covering difficulties encountered in demolition work will not be recognized.

1.04 GENERAL REQUIREMENTS

A. Comply with all applicable federal, state and local codes and ordinances and with the requirements of insurance carriers providing coverage for this work.

B. Comply with all Texas Department of Health (TDH) and EPA notification requirements.

C. Removal of existing resilient floor coverings and adhesives shall comply with the work practices recommended by the Resilient Floor Covering Institute's "Recommended Work Practices for the Removal of Resilient Floor Coverings" dated August, 1995. In addition, asbestos-containing flooring materials shall be removed in compliance with the same RFCI recommendations, and OSHA, EPA and any state and local standards or requirements.

D. Contractor shall provide to the Owner at the pre-construction conference documentation confirming abatement contractor and all workmen involved with the demolition have received required training and licensing, as per TDH, EPA, RFCI, and OSHA requirements.

E. Procure and pay for all permits or certificates required for the work involved.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.01 PROTECTION OF EXISTING FACILITIES

A. The Contractor shall take all necessary precautions to insure against damage to existing work to remain in place, and any damage to such work shall be repaired or replaced as approved by the Architect at no additional cost to the Owner.

3.02 ABATEMENT

A. A pre-demolition asbestos survey was conducted, the results of which are incorporated herein. Contractor shall determine extent of work required and execute the necessary work, in a manner compliant with Authorities having jurisdiction, to address the following materials as applicable:

1. Transite pipe.
2. Ceiling tile and mastic.
3. Vinyl floor tile and mastic.
4. Drywall textures/wallcovering.
5. Any other material as identified in Survey.

B. Before commencing general demolition activities, Federal and State law requires that all asbestos-containing materials that could possibly be disturbed during such activities be abated. It has been determined that the necessary work will disturb the known asbestos-containing building materials (ACBM). Therefore, the General Contractor is required to secure the necessary services of a Texas Licensed Asbestos Consultant and a Texas Licensed Asbestos Abatement Contractor to affect removal of the aforementioned ACBM prior to initiating any work at the Subject Property that could possibly disturb any of the ACBM.

C. It is the responsibility of the General Contractor to determine and certify that all asbestos-related work is performed by properly licensed, trained and experienced personnel, and that all work pertaining to the removal of ACBM meet all applicable requirements of:
1. Texas Asbestos Health Protection Rules, Sections 295.31 through 295.73, March 2003.
2. The National Emission Standard for Hazardous Pollutants (NESHAP), Asbestos Regulations (40 CFR 61, Subpart M).
3. Applicable regulations of the Occupational Safety and Health Administration (OSHA), including 29 CFR 1910.134 and 29 CFR 1926.
4. AHERA Regulations 40 CFR Part 763, Subpart E, Appendix C, as it applies to accreditation of asbestos abatement contractor personnel.

D. The required third party air quality monitoring shall be commissioned and paid for by the Contractor.

3.03 DEMOLITION

A. Existing finish flooring, including mastic, shall be completely removed and the substrate prepared to receive the new flooring.

B. Erect necessary barricades and protective measures as required.

3.04 DISPOSAL

A. Except as otherwise provided, all items demolished or cleared from the building resulting from the work of this section shall be removed and disposed of off-site in a TDH/EPA approved disposal site with a documented manifest provided to the Owner at project close-out.

END OF SECTION 02 80 00

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

1. Footings.
2. Slabs-on-grade.
3. Suspended slabs.
4. Concrete toppings.
5. Building frame members.
6. Building walls.
7. Drilled Piers

B. WORK INCLUDED

1. Design, fabrication, erection, and stripping of formwork for cast-in-place concrete including shoring, reshoring, falsework, bracing, proprietary forming systems, prefabricated forms, void forms, permanent metal forms, bulkheads, keys, blockouts, sleeves, pockets, and accessories. Erection shall include installation in formwork of items furnished by other trades.
2. Furnish all labor and materials required to fabricate, deliver and install reinforcement and embedded metal assemblies for cast-in-place concrete, including steel bars, welded steel wire fabric, ties and supports.
3. Furnish all labor and materials required to perform the following:
   a. Cast-in-place concrete
   b. Concrete mix designs
   c. Grouting structural steel baseplates
   d. Concrete for drilled piers

C. Related Sections include the following:
1. Division 31 Section “Drilled Piers” for drilled concrete piers.
2. Division 32 Section “Concrete Paving” for concrete pavement and walks.

1.03 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, Slag Cement, and silica fume; subject to compliance with requirements.

1.04 SUBMITTALS

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

B. Design Mixtures: For each concrete mixture submit proposed mix designs in accordance with ACI 318, chapter 5. Each proposed mix design shall be accompanied by a record of past performance.
   1. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
   2. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

   1. Do not reproduce the structural drawings for use as shop drawings.
   2. Embedded metal assemblies: Submit shop drawings for fabrication and placement. Use standard AWS welding symbols.

D. Steel Reinforcement Submittals for Information: Mill test certificates of supplied concrete reinforcing, indicating physical and chemical analysis.

E. Formwork Shop Drawings: Prepared and sealed by a qualified professional engineer, licensed in the State where the project is located, detailing fabrication, assembly, and support of formwork.

   1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and installing and removing reshoring.

F. Welding certificates.

G. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

   1. Aggregates.

H. Material Certificates: For each of the following, signed by manufacturers:

   1. Cementitious materials
   2. Admixtures
   3. Form materials and form-release agents
   4. Steel reinforcement and accessories
   5. Waterstops
   6. Curing compounds
   7. Floor and slab treatments
   8. Bonding agents
   9. Adhesives
   10. Vapor retarders
   11. Joint-filler strips
   12. Repair materials

I. Submit manufacturer's certification of maximum chloride ion content in admixtures.

J. Fly ash: Submit certification attesting to carbon content and compliance with ASTM C618.

K. Construction Joint Layout: Submit a diagram of proposed construction joint locations for horizontal framing that exceed the limits of a single placement as stated in the structural notes, other than those indicated on the Drawings.

L. Floor surface flatness and levelness measurements to determine compliance with specified tolerances.

M. Field quality-control test and inspection reports.

N. Minutes of preinstallation conference.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

E. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."

F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specification for Structural Concrete,"
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

G. Concrete Testing Service: Owner may engage a qualified independent testing agency to perform material evaluation tests.

H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.

d. Concrete subcontractor.

2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

C. Store all proprietary materials in accordance with manufacturer's recommendations.

PART 2 - PRODUCTS

2.01 CONCRETE, GENERAL

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

1. ACI 301 (ACI 301M).
2. ACI 117 (ACI 117M).

2.02 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

a. High-density overlay, Class 1 or better.

3. Steel Forms

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
1.

C. Void Forms: Shall be the product of a reputable manufacturer regularly engaged in the commercial production of void forms.

1. Void form composition shall be of corrugated paper material with a moisture resistant exterior and an interior fabrication of a uniform cellular configuration, composed of components constructed of double-faced wax-impregnated (partially or fully), corrugated fiberboard that is laminated with moisture resistant adhesive.

2. Design and maintain void forms to support all vertical and lateral loads that might be applied during construction until such loads can be supported by the concrete structure.
3. Form material shall be designed to lose its strength under prolonged contact with the moisture which normally accumulates beneath slabs and beams on grade.
4. Void forms shall be used around the circular edges of all drilled piers at the intersection of the gradebeams and/or structural slabs by using premanufactured, non-field cut, sealed void forms with curved edges adjacent to drilled piers.
5. Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, VoidForm Products, Inc., Englewood, Colorado.

D. Protection Board: For use over void forms under structural slabs. Hard-pressed cellulose fiber board, 1/8 inch minimum thickness.

E. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

F. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

G. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

H. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

I. Expanded Polystyrene (EPS) Geofoam:

1. Lightweight expanded polystyrene with a minimum compressive strength of 2.2 pounds per square inch (psi) at a 1% deformation.
2. Geofoam shall be in compliance with ASTM D 6817.
3. Geofoam shall be shaped to provide continuous support for raised slabs or to act as a lightweight fill material at locations indicated on the drawings.
4. All Geofoam blocks shall be treated by the manufacturer with a tested and proven termite treatment for below grade applications, 3 year minimum field exposure. The treatment shall be EPA registered, meet the requirements of ICC ES AC 239, and be recognized in an ICC ES report.
5. Available Products:
   a. Foam-Control EPS Geofoam, AFM Corporation.
   b. InsulFoam GF, Insulfoam, LLC.

J. Soil Retainers: Shall be provided where specified and shown on the drawings to prevent migration of backfill under suspended foundation elements:

1. Retainers shall be composed of high density polypropylene materials that are not adversely affected by moisture. They must be flexible, impact resistant and have sufficient strength to resist lateral loads applied by soil.

a. Thickness: 3/8” for void spaces of 8” or less **[1/2” for void spaces greater than 8”, but less than 12”, inclusive].**
b. Soil retainers shall extend six inches above the void forms and a minimum of 3 inches below the void forms.

2.03 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 60 percent.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

C. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

D. Deformed-Bar Anchor: ASTM A1064/ A1064M.

E. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

2.04 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. For slabs on grade and slabs on void forms, provide sand plates, horizontal runners, or precast concrete blocks on bottom where base material will not support chair legs or where vapor barrier has been specified.

2.05 MECHANICAL SPLICES

A. Provide mechanical splices designed to develop, in tension and compression, 125 percent of the minimum ASTM specified yield strength of the smaller bar being spliced. The following splicing systems are acceptable:

1. Erico "Cadweld T-Series"
2. Erico "Lenton"
3. Dayton Barsplice "Bar-Grip"
4. Dayton Barsplice "Grip-Twist"

2.06 DOWEL BAR ANCHORS

A. Provide dowel bar anchors and threaded dowels designed to develop, in tension and compression, 125 percent of the minimum ASTM specified yield strength of the dowel bars. Unless otherwise indicated, anchors shall be furnished with ACI standard 90 degree hooks. Dowels shall be furnished by the anchor supplier. The following dowel splicing systems are acceptable:

1. Richmond Screw Anchor "Dowel Bar Splicer"

2. Erico "Lenton Form Saver"
3. Dayton Barsplice "Grip-Twist"

2.07 EMBEDDED METAL ASSEMBLIES

A. Steel Shapes and Plates: ASTM A36

B. Headed Studs: Heads welded by full-fusion process, as furnished by TRW Nelson Stud Welding Division.

C. Welded Deformed Bar Anchors: ASTM A1064/ A1064M: Welded by full fusion process, as furnished by TRW Nelson Stud Welding Division.

D. Reinforcing Bars to be Welded: ASTM A706.

E. Coatings

1. Epoxy coating for metal assemblies shall be "Hi-Build Epoxoline," as manufactured by the Tnemec Company, Kansas City, Missouri, applied in accordance with manufacturer's recommendations.

2.08 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I/II, gray. Supplement with the following:

a. Fly Ash: ASTM C 618, Class F or C.
b. Slag Cement: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C 33, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: As indicated on drawings.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 1602/C 1602M and potable.

2.09 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.10 WATERSTOPS

A. Waterstops: At all construction joints below grade. "Synko-Flex" Preformed Plastic Waterstop by the Henry Company, Inc., meeting the requirements of Federal Specification SSS-210.

B. VAPOR RETARDERS

C. Plastic Vapor Retarder: ASTM E 1745, Class A.

1. Membrane shall have the following properties:

   a. Minimum 15 mils thickness.
   b. Permeance Rating: ASTM E96, 0.01 Perms [grains/(ft^2 * hr *- in Hg)] or lower as tested after mandatory conditioning (ASTM E 154 sections 8, 11, 12, 13)
   c. Installation shall be in accordance with ASTM E1643 and manufacturer's instructions.

2. Products:

   a. Carlisle Coatings & Waterproofing, Inc.: Blackline 400.
   b. Epro; Ecoshield-E 15 mil.
   c. Inteplast Group; Barrier Bac VBC-350 Composite Vapor Retarder
   d. Reef Industries; Vaporguard.
   e. Stego Wrap 15 mil, by Stego.
   f. W.R. Meadows, Inc.: Premolded Membrane with Plasmatic Core (PMPC).

3. Accessories

   a. Perimeter/seam sealing tape for use with membranes that are not self-adhering to the underside of concrete slabs on void forms:
      1) Crete Claw detail tape by Stego Industries, LLC, for adhering vapor retarder membrane to the underside of concrete surface at slabs on carton void forms, 3-inch and 6-inch widths as noted in Part 3.
      2) StegoTack double-sided adhesive tape by Stego Industries, LLC, for adhering membrane to concrete at gradebeams.
   b. Manufacturer's recommended standard adhesive or pressure sensitive tape for general use.

2.11 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Products:

   a. Axim Concrete Technologies; CATEXOL Cimfilm.
   b. BASF Construction Chemicals – Building Systems; Confilm.
   c. ChemMasters; Spray-Film.
   d. Conspec by Dayton Superior; Aquafilm.
   e. Dayton Superior Corporation; Sure Film (J-74).
   f. Edoco by Dayton Superior; BurkeFilm.
   g. Euclid Chemical Company (The), an RPM company; Eucobar.
   h. Kaufman Products, Inc.; Vapor Aid.

i. Lambert Corporation; LAMBCO Skin.
j. L&M Construction Chemicals, Inc.; E-Con.
k. Meadows, W. R., Inc.; EVAPRE.
l. Metalcrete Industries; Waterhold.
m. Nox-Crete Products Group; Monofilm.
n. Sika Corporation, Inc.; SikaFilm.
o. SpecChem, LLC; Spec Film.
p. Symons by Dayton Superior; Finishing Aid.
q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
r. Unitex; Pro-Film.
s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

1. Products:

a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
b. BASF Construction Chemicals – Building Systems; Kure 200.
c. ChemMasters; Safe-Cure Clear.
d. Conspec by Dayton Superior; W.B. Resin Cure.
e. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
f. Edoco by Dayton Superior; Res X Cure WB.
g. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
h. Kaufman Products, Inc.; Thinfilm 420.
i. Lambert Corporation; Aqua Kure-Clear.
j. L&M Construction Chemicals, Inc.; L&M Cure R.
k. Meadows, W. R., Inc.; 1100 Clear.
l. Nox-Crete Products Group; Resin Cure E.
m. Right Pointe; Clear Water Resin.
n. SpecChem, LLC; Spec Rez Clear.
o. Symons by Dayton Superior; Resi-Chem Clear.
p. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
q. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.

F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

1. Products:

a. Anti-Hydro International, Inc.; AH Clear Cure WB.
b. BASF Construction Chemicals – Building Systems; Kure-N-Seal WB.

c. ChemMasters; Safe-Cure & Seal 20.
d. Conspec by Dayton Superior; Cure and Seal WB.
e. Cresset Chemical Company; Crete-Trete 309-VOC Cure & Seal.
f. Dayton Superior Corporation; Safe Cure and Seal (J-18).
g. Edoco by Dayton Superior; Spartan Cote WB II.
h. Euclid Chemical Company (The), an RPM company; Aqua Cure VOX; Clearseal WB 150.
i. Kaufman Products, Inc.; Cure & Seal 309 Emulsion.
j. Lambert Corporation; Glazecote Sealer-20.
k. L&M Construction Chemicals, Inc.; Dress & Seal WB.
l. Meadows, W. R., Inc.; Vocomp-20.
m. Metalcrete Industries; Metcure.
n. Nox-Crete Products Group; Cure & Seal 150E.
o. Symons by Dayton Superior; Cure & Seal 18 Percent E.
p. TK Products, Division of Sierra Corporation; TK-2519 WB.
q. Vexcon Chemicals, Inc.; Starseal 309.

G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating**,** certified by curing compound manufacturer to not interfere with bonding of floor covering.

1. Products:

a. BASF Construction Chemicals – Building Systems; Kure-N-Seal W.
b. ChemMasters; Safe-Cure Clear.
c. Conspec by Dayton Superior; High Seal.
d. Dayton Superior Corporation; Safe Cure and Seal (J-19).
e. Edoco by Dayton Superior; Spartan Cote WB II 20 Percent.
f. Euclid Chemical Company (The), an RPM Company; Diamond Clear VOX; Clearseal WB STD.
g. Kaufman Products, Inc.; SureCure Emulsion.
h. Lambert Corporation; Glazecote Sealer-20.
i. L&M Construction Chemicals, Inc.; Dress & Seal WB.
j. Meadows, W. R., Inc.; Vocomp-20.
k. Metalcrete Industries; Metcure 0800.
l. Nox-Crete Products Group; Cure & Seal 200E.
m. Symons by Dayton Superior; Cure & Seal 18 Percent E.
n. Vexcon Chemicals, Inc.; Starseal 0800.

2.12 RELATED MATERIALS

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

B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

C. Sleeves and Blockouts: Formed with galvanized metal, galvanized pipe, polyvinyl chloride pipe, fiber tubes, or wood.

D. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required; of strength and character to maintain formwork in place while placing concrete.

2.13 REPAIR MATERIALS

A. Repair Mortar – Hand-Applied: Pre-packaged, cement-based, two-component, polymer-modified, trowel-grade mortar, enhanced with penetrating corrosion inhibitor.
   1. Compressive Strength: 1200 psi minimum at 1 day; 6000 psi minimum at 28 days when tested according to ASTM C 109.
   2. Bond Strength: 1800 psi minimum at 28 days when tested according to ASTM C 882 (Modified).
   3. Product / Manufacturer: SikaTop 122 Plus or SikaTop 123 Plus, Sika Corporation, or approved equal.

B. Repair Mortar – Form and Pour or Pump: Pre-packaged, cement-based, single-component, polymer-modified, silica-fume-enhanced, cementitious mortar.
   1. Compressive Strength: 3000 psi minimum at 1 day; 6500 psi at 28 days when tested according to ASTM C 109.
   2. Bond Strength: 2200 psi at 28 days when tested according to ASTM C 882 (modified).
   3. Product / Manufacturer: Sika MonoTop 611, Sika Corporation, or approved equal.

2.14 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

   1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

   2. Required average strength above specified strength:

      a. Based on a record of past performance: Determination of required average strength above specified strength shall be based on the standard deviation record of the results of at least 30 consecutive strength tests in accordance with ACI 318, Chapter 5.3 by the larger amount defined by formulas 5-1 and 5-2.
      b. Based on laboratory trial mixtures: Proportions shall be selected on the basis of laboratory trial batches prepared in accordance with ACI 318, Chapter 5.3.3.2 to produce an average strength greater than the specified strength f'c by the amount defined in table 5.3.2.2.

         1) Proportions of ingredients for concrete mixes shall be determined by an independent testing laboratory or qualified concrete supplier.
         2) For each proposed mixture, at least three compressive test cylinders shall be made and tested for strength at the specified age. Additional cylinders may be made for testing for information at earlier ages.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

   1. Fly Ash: 20 percent.
   2. Combined Fly Ash and Pozzolan: 25 percent.
   3. Slag Cement: 50 percent.
   4. Combined Fly Ash or Pozzolan and Slag Cement: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.

   5.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Do not use admixtures which have not been incorporated and tested in accepted mixes.
2. Use water-reducing admixture in concrete, as required, for placement and workability.
3. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
4. Use water-reducing admixture in pumped concrete, and concrete with a water-cementitious materials ratio below 0.50.

2.15 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Proportion normal-weight concrete mixture as indicated on drawings.

2.16 FABRICATING REINFORCEMENT

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

2.17 FABRICATION OF EMBEDDED METAL ASSEMBLIES

A. Fabricate metal assemblies in the shop. Holes shall be made by drilling or punching. Holes shall not be made by or enlarged by burning. Welding shall be in accordance with AWS D1.1.

B. Welding of deformed bar anchors and headed stud anchors shall be done by full fusion process equal to that of TRW Nelson Stud Welding Division. A minimum of two headed studs shall be tested at the start of each production period for proper quality control. The studs shall be capable of being bent 45 degrees without failure.

C. Welding of reinforcement shall be done in accordance with AWS D1.4, using the recommended preheat temperature and electrode for the type of reinforcement being welded. Bars larger than no. 9 shall not be welded. Welding shall be subject to the observance and testing of the Testing Laboratory.

D. Metal assemblies exposed to earth, weather or moisture shall be hot dip galvanized. All other metal assemblies shall be either hot dip galvanized or painted with an epoxy paint. Repair galvanizing after welding with a Cold Galvanizing compound installed in accordance with the manufacturer's instructions. Repair painted assemblies after welding with same type of paint.

2.18 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and furnish batch ticket information.

1. When air temperature is between 85 and 95 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 95 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.01 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

1. Vertical alignment:

   a. Lines, surfaces and arises less than 100 feet in height - 1 inch.
   b. Outside corner of exposed corner columns and control joints in concrete exposed to view less than 100 feet in height - 1/2 inch.

2. Lateral alignment:

   a. Members - 1 inch.
   b. Centerline of openings 12 inches or smaller and edge location of larger openings in slabs - 1/2 inch.
   c. Sawcuts, joints, and weakened plane embedments in slabs - 3/4 inch.

3. Level alignment:

   a. Elevation of slabs-on-grade - 3/4 inch.
   b. Elevation of top surfaces of formed slabs before removal of shores - 3/4 inch.
   c. Elevation of formed surfaces before removal of shores - 3/4 inch.
   d. Lintels, sills, parapets, horizontal grooves, and other lines exposed to view - 1/2 inch.

4. Cross-sectional dimensions: Overall dimensions of beams, joists, and columns and thickness of walls and slabs.

   a. 12 inch dimension or less - plus 3/8 inch to minus 1/4 inch.
   b. Greater than 12 inch to 3 foot dimension - plus 1/2 inch to minus 3/8 inch.
   c. Greater than 3 foot dimension - plus 1 inch to minus 3/4 inch.

5. Relative alignment:

   a. Stairs:

      1) Difference in height between adjacent risers - 1/8 inch.
      2) Difference in width between adjacent treads - 1/4 inch.
      3) Maximum difference in height between risers in a flight of stairs - 3/8 inch.
      4) Maximum difference in width between treads in a flight of stairs - 3/8 inch.

   b. Grooves:

      1) Specified width 2 inches or less - 1/8 inch.
      2) Specified width between 2 inches and 12 inches - 1/4 inch.

   c. Vertical alignment of outside corner of exposed corner columns and control joint grooves in concrete exposed to view - 1/4 inch in 10 feet.
   d. All other conditions - 3/8 inch in 10 feet.

C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

1. Class A, 1/8 inch for smooth-formed finished surfaces.
2. Class C, 1/2 inch for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide elevation or camber in formwork as required for anticipated formwork deflections due to weight and pressures of concrete and construction loads.

H. Foundation Elements: The sides of all below grade portions of beams, pier caps, walls, and columns shall be formed straight and to the lines and grades specified. Foundation elements shall not be earth formed unless specifically indicated on the Drawings.

I. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

J. Chamfer exterior corners and edges of permanently exposed concrete.

K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

L. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

M. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

N. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement, anchoring devices, and embedded items.

1. Do not apply form release agent where concrete surfaces are scheduled to receive subsequent finishes which may be affected by agent. Soak contact surfaces of untreated forms with clean water. Keep surfaces wet prior to placing concrete.

3.02 EMBEDDED ITEMS

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

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

a. Spacing within a bolt group: 1/8"

b. Location of bolt group (center): 1/2"
c. Rotation of bolt group: 5 degrees
d. Angle off vertical: 5 degrees
e. Bolt projection: ± 3/8"

2. Headed Studs: Heads welded by full-fusion process, as furnished by TRW Nelson Stud Welding Division.

3. Welded Deformed Bar Anchors: ASTM A1064/ A1064M: Welded by full fusion process, as furnished by TRW Nelson Stud Welding Division.

3.03 VOID FORMS

A. Install void forms in all locations shown on the Drawings. In general, void forms shall be placed below all structural elements supported by piers to separate these elements from the earth.

B. Seal discontinuous ends of void forms and tape all joints with waterproof tape so that concrete will not enter the void space during placement of concrete. Do not leave gaps between void form sections.

C. Premanufactured void forms with circular edges shall be used around all drilled piers. Field fabrication of pier void forms is not permitted.

D. Do not allow any portion of void forms to fall within the circumference of piers causing a reduction in the bearing area.

E. Protect void forms from water. Do not install void forms during wet weather or on wet ground. Void forms which become saturated prior to placement of concrete shall be removed and replaced. Void forms shall not be wrapped in plastic, or other similar material to protect from moisture when installed.

F. Exercise care in placement of concrete to avoid collapse of void form. If void forms collapse, soil beneath the concrete shall be dug out and a proper void space shall be created by installing soil retainers on each side of element.

G. Void forms under slabs shall be protected by a layer of one-eighth inch thick protection board followed by a vapor barrier or retarder per the specifications. Do not install void forms under soil supported slabs on grade.

3.04 SOIL RETAINERS

A. Install soil retainers in straight, clean trenches at sides of void forms prior to concrete placement. The gaps between the trench and retainers must be properly positioned or backfilled prior to the placement of concrete. Do not cast the sides of concrete beams directly against the soil.

B. Affix the soil retainers to the concrete beam with adhesive, pin/washer/load, or concrete hard nails spaced on 24 inch centers.

3.05 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
2. Formwork supporting conventionally reinforced concrete shall not be removed until concrete has attained 85 percent of its specified 28 day compressive strength as established by tests of field cured cylinders. In the absence of cylinder tests, supporting formwork shall remain in place until the concrete has cured at a temperature of at least 50 degrees Fahrenheit (10 degrees Celsius) for the minimum cumulative time periods given in ACI 347, Section 3.7.2.3. When the surrounding air temperature is below 50 degrees Fahrenheit (10 degrees Celsius), that time period shall be added to the minimum listed time period. Formwork for two-way conventionally reinforced slabs shall remain in place for at least the minimum cumulative time periods specified for one-way slabs of the same maximum span.
3. Two-way conventionally reinforced slabs shall be immediately reshored after formwork removal. Reshores shall remain until the concrete has attained the specified 28 day compressive strength.
4. Minimum cumulative curing times may be reduced by the use of high-early strength cement or forming systems which allow form removal without disturbing shores, but only after the Contractor has demonstrated to the satisfaction of the Architect that the early removal of forms will not cause excessive sag, distortion or damage to the concrete elements.
5. Forms for post-tensioned concrete shall not be removed until tensioning operations have been completed.
6. Wood forms shall be completely removed. Provide temporary openings if required.
7. Provide adequate methods of curing and thermal protection of exposed concrete if forms are removed prior to completion of specified curing time.
8. Areas required to support construction loads in excess of 20 psf shall be reshored to properly distribute construction loading. Construction loads up to the rated live load capacity may be placed on unshored construction provided the concrete has attained the specified 28 day compressive strength.
9. Obtaining concrete compressive strength tests for the purposes of form removal shall be the responsibility of the Contractor.
10. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.06 SHORES AND RESHORES

A. The Contractor shall be solely responsible for proper shoring and reshoring.

B. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.07 VAPOR RETARDERS

A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.

B. Lap joints 6 inches and seal with tape as noted below.

1. Vapor retarder membrane seal at slabs on void forms for use with membranes that are not self-adhering to the underside of concrete slabs: Seal vapor retarder membrane to underside of slab using perimeter/seam seal tape applied continuously to perimeter of vapor retarder membrane at grade beams (3in. tape) and at the seams at interior conditions (6in. tape).
   a. Apply double-sided adhesive tape top surface of grade beam and adhere membrane to tape. Refer to the drawings for detail.
   b. Remove any dirt or debris from membrane prior to application of sealing tape.

2. General sealing and at slabs on grade: Use manufacturer’s standard adhesive or pressure sensitive tape for sealing membrane at seams, pipe penetrations, tears, etc.

3.08 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4, where indicated. Only steel conforming to ASTM A706 may be welded.

D. Installation tolerances:

1. Top and bottom bars in slabs, girders, beams and joists:

   a. Members 8" deep or less: ±3/8"
   b. Members more than 8" deep: ±1/2"

2. Concrete Cover to Formed or Finished Surfaces: ±3/8" for members 8" deep or less; ±1/2" for members over 8" deep, except that tolerance for cover shall not exceed 1/3 of the specified cover.

E. Concrete Cover: Refer to the Structural Notes.

F. Splices: Provide standard reinforcement splices by lapping and tying ends. Comply with ACI 318 for minimum lap of spliced bars where not specified on the documents.

G. Mechanical Splices: Use for splicing of bars larger than no. 11 or where no. 11 bars are spliced to larger size bars and where indicated on the drawings. Comply with manufacturer's instructions for preparation of bars and installation procedures.

H. Field Welding of Embedded Metal Assemblies: All paint and galvanizing shall be removed in areas to receive field welds. All areas where paint or galvanizing has been removed shall be field repaired with the specified paint or cold galvanizing compound, respectively.

I. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

J. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.09 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.10 WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

3.11 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, and only if specifically noted as withheld on the batch ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
2. Water content shall not exceed the maximum specified water/cement ratio for the mix.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
4. Do not permit concrete to drop freely any distance greater than 20'-0" for concrete containing a high range water reducing admixture (superplasticizer) or 5'-0" for other concrete. Provide chute or tremie to place concrete where longer drops are necessary. Do not place concrete into excavations with standing water. If place of deposit cannot be pumped dry, pour concrete through a tremie with its outlet near the bottom of the place of deposit.
5. Pump priming grout shall be discarded and not used in the structure.

D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

F. Hot-Weather Placement: Comply with ACI 305.1 and as follows:

1. Maintain concrete temperature below 95 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.12 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete.

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

3.13 MISCELLANEOUS CONCRETE ITEMS

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

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

1. Housekeeping pads: Concrete fill shall be normal weight concrete (3000 psi), reinforced with 4x4-W2.1xW2.1 welded wire mesh set at middepth of pad. Trowel concrete to a dense, smooth finish. Set anchor bolts for securing mechanical or electrical equipment during pouring of concrete fill.

3.14 INSTALLATION OF NON-SHRINK GROUT UNDER BASEPLATES

A. Grout under all bearing and baseplates. Comply with manufacturer's instructions. Do not dry pack.

B. Mixing: Use a mechanical mixer. Add only enough water to make grout placeable. Do not mix more grout than can be used in 20 minutes. Under no circumstances shall grout be retempered.

3.15 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305.1 for hot-weather protection during curing.

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

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.

b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

   a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.16 CONCRETE SURFACE REPAIRS

A. Surface Defects in Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Owner's approval.

B. Contractor shall submit a detailed, descriptive procedure listing proposed pre-packaged repair materials and methods for the repair of surface defects prior to the start of repair work.

C. Patching Mortar: Mix, place and finish pre-packaged repair mortar in accordance with manufacturer’s instructions.

D. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, minor honeycombs and rock pockets with no exposed reinforcement, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

   1. Immediately after form removal, cut out minor honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface, 1/4 inch deep minimum. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
   2. Repair defects on surfaces exposed to view using pre-packaged repair mortar so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

E. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

   1. Repair finished surfaces containing defects. Surface defects include minor spalls, pop outs, honeycombs and rock pockets with no exposed reinforcement, crazing and cracks in excess

of 0.01 inch wide that do not penetrate to reinforcement, and other objectionable conditions.

2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with patching mortar. Remove defective areas with clean, square cuts, ¼" deep minimum. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Place, compact, and finish patching mortar to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
8. Unapproved and defective repairs shall be removed and replaced in accordance with requirements provided by the Engineer at no additional cost to the Owner.

3.17 STRUCTURAL REPAIRS

A. Structurally Defective Concrete: Structural defects include spalls, honeycombs or rock pockets with exposed reinforcement, hollow-sounding concrete, cracks that penetrate to the reinforcement or completely through concrete elements, inadequate cover over reinforcement, and other conditions that affect the structural performance or durability of the concrete as determined by the Engineer.

B. Repair structural defects in concrete in accordance with plans, specifications, details, etc. provided by the Engineer.

   1. The cost of the additional services provided by the Engineer to prepare the repair documents, and to oversee the repair work shall be borne by the Contractor.

C. Unapproved and defective repairs shall be removed and replaced in accordance with requirements provided by the Engineer at no additional cost to the Owner.

3.18 CLEANUP

A. Imperfect or damaged work or any material damaged or determined to be defective before final completion and acceptance of the entire job shall be satisfactorily replaced at the Contractor's expense, and in conformity with all of the requirements of the Drawings and Specifications. Removal and replacement of concrete work shall be done in such manner as not to impair the appearance or strength of the structure in any way.

B. Cleaning: Upon completion of the work all forms, equipment, protective coverings and any rubbish resulting therefrom shall be removed from the site. After sweeping floors, wash floors with clean water. Finished concrete surfaces shall be left in a clean condition, satisfactory to the Owner.

3.19 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner may engage a special inspector and/or a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections may include:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.

    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
6. Compression Test Specimens: ASTM C 31/C 31M.

    a. Cast and laboratory cure four cylinders for each composite sample.

        1) Do not transport field-cast cylinders until they have cured for a minimum of 24 hours.

7. Compressive-Strength Tests: ASTM C 39/C 39M;

    a. Test one cylinder at 7 days
    b. Test two cylinders at 28 days

c. Test one cylinder at 56 days
d. If 4” by 8” cylinders are used, provide 1 additional cylinder at each stage

8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
9. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.

    a. When the strength level of the concrete for any portion of the structure, as indicated by cylinder tests, falls below the specified requirements, the Contractor shall provide improved curing conditions and/or adjustments to the mix design as required to obtain the required strength. If the average strength of the laboratory control cylinders falls so low as to be deemed unacceptable, the Contractor shall follow the core test procedure set forth in ACI 301, Section 1.6. Locations of core tests shall be approved by the Architect. Core sampling and testing shall be at Contractors expense.
    b. If the results of the core tests indicate that the strength of the structure is inadequate, any replacement, load testing, or strengthening as may be ordered by the Architect shall be provided by the Contractor without cost to the Owner.

12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.

END OF SECTION 03 30 00

SECTION 033500 - CONCRETE FLOOR FINISHING

PART 2 - GENERAL

2.01 RELATED DOCUMENTS

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

2.02 SUMMARY

A. This Section includes the following:

1. Finishing slabs-on-grade, monolithic floor slabs, and separate floor toppings.
2. Surface treatment with concrete hardener, sealer, and slip resistant coatings.

B. Related Sections include the following:

1. Division 3 Section "Cast-in-Place Concrete" for concrete slab construction and finish.
2. Division 5 Section “Expansion Joint Assemblies”
3. Division 7 Section “Joint Sealers”
4. Division 9 Section "Ceramic Tile" for medium-set and thickset mortar beds for tile.

2.03 REFERENCES

A. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.

1. ACI 301 - Specifications for Structural Concrete for Buildings
2. ACI 302 - Guide for Concrete Floor and Slab Construction
3. ASTM E1155 - Determining Floor Flatness and Levelness Using the F-Number System (Inch-Pound Units).

2.04 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

B. Submittals

1. Product Data: Submit manufacturer's data showing compliance with the specifications for the following products:

   a. Concrete hardener
   b. Sealer
   c. Slip resistant treatments

2.

C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

1. The Contractor shall call a meeting to review the detailed requirements for floor construction, including the concrete placing techniques, finishing techniques, curing techniques, and the application of floor finishing materials. All contractors involved in the floor installation shall attend the conference.

2. The Contractor shall notify the Owner, Architect and the Structural Engineer at least 10 business days prior to the scheduled date of the conference.

2.05 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, mixing with other components, and application.

B. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.

PART 3 - PRODUCTS

3.01 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

3.02 RELATED MATERIALS

A. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, aromatic polyurea with a Type A Shore durometer hardness range of 90 to 95 per ASTM D 2240.

B. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

C. Joint Sealant: For sealing control joints and construction joints in parking decks. "Iso-Flex 880 GB" (self-leveling) or "Iso-Flex 881" (non-sag) polyurethane type by the H.S. Peterson Corporation or approved equal. Provide all primers, cleaners and materials required by the manufacturer for the installation of sealant.

D. Sawcut joint filler: Euco 700 epoxy by The Euclid Chemical Company, or approved equal.

PART 4 - EXECUTION

4.01 FINISHING FLOORS AND SLABS

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

B. Concrete slabs shall be finished as specified below, within the tolerances specified elsewhere in this Section.

1. Highway straightedges are recommended for use in lieu of bullfloats for all slab placement and finishing operations.
2. Screeding: Immediately after placing, slab shall be vibrated and struck off true by double screeding to the required level, at or below the elevation or grade of the finished slabs as indicated on the Drawings. Vibrators shall not be used to spread the concrete. When camber is indicated for slabs supported on formwork, screed to the required camber. Fixed screed guides are recommended where specified surface tolerance exceeds FF25/FL20.
3. Floating: Immediately after screeding, before any excess bleed water is present on the surface, float the surface using long-handled bull floats or darbies.
4. Straightedging: Immediately after screeding and before excess bleed water is present on the surface, straighten the surface using a highway straightedge.
5. Edging and jointing, where required, shall be done after bleed water has evaporated and before further finishing.

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

1. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
2. Locations: All concrete surfaces under waterproofing membrane, setting beds for brick, mud-set tile, pavers, or terrazzo, and noncomposite topping slabs.

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

1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
2. Locations: Exposed concrete floors not otherwise specified, concrete surfaces under carpets, vinyl tile, thin set tile, wood flooring, elastomeric coatings, and painted concrete floors, and roof slabs that are future floors.

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

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

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

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

4.02 CONTROL JOINTS

A. Saw-cut Control Joints: Form weakened-plane control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete floor topping when cutting action will not tear, abrade, or otherwise damage surface and before random contraction cracks develop.

B. Form joints in concrete floor topping over control joints in base slabs, unless otherwise indicated.

C. Construct control joints for a combined depth equal to topping thickness and not less than one-fourth of base-slab thickness.

D. Construct control joints for a depth equal to one-half of concrete floor topping thickness, but not less than 1/2 inch deep.

4.03 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least [**one**] [**six**] month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

1. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

4.04 CONCRETE FINISH MEASUREMENT AND TOLERANCES

A. Two Tiered Measurement Standard: Each floor test section and the overall floor area shall conform to the two-tiered measurement standard as specified herein.

1. Minimum Local Value: The minimum local FF/FL values represent the absolute minimum surface profile that will be acceptable for any one test sample (line of measurements) anywhere within the test area.
2. Specified Overall Value: The specified overall FF/FL values represent the minimum values acceptable for individual floor sections as well as the floor as a whole.

B. Floor Test Sections

1. A floor test section is defined as the smaller of the following areas:

a. The area bounded by column and/or wall lines.
b. The area bounded by construction and/or control joint lines.
c. Any combination of column lines and/or control joint lines.

2. Test sample measurement lines within each test section shall be multidirectional along two orthogonal lines, as defined by ASTM E1155, at a spacing to be determined by the Owner's testing agency.
3. The precise layout of each test section shall be determined by the Owner's testing agency.

C. Concrete Floor Finish Tolerance

1. The following values apply before removal of shores. Levelness values (FL) do not apply to intentionally sloped or cambered areas, nor to slabs poured on metal deck or precast concrete.
   a. Suspended/Structured Slabs:
      1) Floors to be covered with carpet or vinyl tile, unless otherwise specified:
         a) Overall Value FF25/FL20
         b) Minimum Local Value FF17/FL15
      2) Floors to be covered with thin-set tile:
         a) Overall Value FF35/FL20
         b) Minimum Local Value FF24/FL15
      3) Mechanical rooms, thickset tile, recessed floors and roof slabs:
         a) Overall Value FF20/FL15
         b) Minimum Local Value FF15/FL10
      4) Exhibit Hall
         a) Overall Value FF30/FL25

b) Minimum Local Value FF20/FL17

D. Floor Elevation Tolerance Envelope:

1. The acceptable tolerance envelope for absolute elevation of any point on the slab surface, with respect to the elevation shown on the Drawings, is as follows:

   a. Slab-on-Grade Construction: +/- 3/4"- Typ. U.N.O.
   b. Top surfaces of formed slabs measured prior to removal of supporting shores: +/- 3/4"
   c. Top surfaces of all other slabs: +/- 3/4"
   d. Slabs specified to slope shall have a tolerance from the specified slope of 3/8" in 10'-0" at any point, up to 3/4" from theoretical elevation at any point.

4.05 FIELD QUALITY CONTROL

A. Concrete Floor Flatness and Levelness:

1. Measurement Standard: Floors shall be measured for flatness and levelness according to ASTM E1155, "Standard Test Method for Determining Floor Flatness and Levelness Using the F-Number System." Tolerances are specified in Section 033000.
2. Time Period for Measuring and Reporting: All measurements shall be made by the testing laboratory or designated agency before the end of the next workday after the completion of finishing operations. For structural elevated floors, measurement shall also be made prior to removal of forms and shores. The Contractor shall be notified immediately after the measurements of any section are complete, and a written report of the floor measurement results shall be submitted within 72 hours after finishing operations are complete. The Contractor shall take immediate action to correct any work that is outside the specified tolerances.
3. Measuring Equipment: The concrete surface profile shall be measured using equipment manufactured for the purpose, such as the Dipstick Floor Profiler, as manufactured by the Edward W. Face Company, Norfolk, Virginia, or by other methods specified in ASTM E1155.
4. Floor Test Sections:

   a. A floor test section is defined as the smaller of the following areas:

      1) The area bounded by column and/or wall lines.
      2) The area bounded by construction and/or control joint lines.
      3) Any combination of column lines and/or control joint lines.

   b. Test sample measurement lines within each test section shall be multidirectional along two orthogonal lines.
   c. The precise layout of each test section shall be determined by the testing agency and shall be submitted for the Architect's review and approval.

4.06 REPAIRS

A. Defective Topping: Repair and patch defective concrete floor topping areas, including areas that have not bonded to concrete substrate.

B. Remedial Measures for Slab Finish Construction not Meeting Specified Tolerances:

1. Application of Remedial Measures. Remedial measures specified herein are required whenever either or both of the following occur:

    a. The composite overall values of flatness or levelness of any test section or the entire floor installation measure less than specified values.
    b. Any individual test sample (line of measurements) measures less than the specified absolute minimum flatness or levelness value.

2. Modification of Existing Surface:

    a. If, in the opinion of the Architect or Owner's representative, all or any portion of the substandard work can be repaired without sacrifice to the appearance or serviceability of the area, the Contractor shall immediately undertake the approved repair method.
    b. The Contractor shall submit for review and approval a detailed work plan of the proposed repair showing areas to be repaired, method of repair, and time required to make the repair.
    c. Repair method(s), at the sole discretion of the Architect or Owner's Representative, may include grinding (floor stoning), planing, retopping with specified floor leveling compound, or any combination of the above.
    d. All repair work shall be performed at no additional cost to the Owner and with no extension to the construction schedule.

3. Removal and Replacement:

    a. If, in the opinion of the Architect/Engineer or Owner's Representative, all or any portion of the substandard work cannot be satisfactorily repaired without sacrifice to the appearance or serviceability of the area, the Contractor shall remove and replace the defective work as directed.
    b. Replacement sections may be retested for compliance at the discretion of the Architect/Engineer or Owner's Representative.
    c. All replacement work shall be performed at no additional cost to the Owner and with no extension to the construction schedule.

END OF SECTION 03 35 00

SECTION 04 42 00 - EXTERIOR STONE CLADDING

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 describes the requirements for furnishing and installing exterior stone work. The work included under this contract shall include all labor and material for the furnishing and installation of cut stone with individual anchors, in accordance with the drawings and specified herein.

B. Related Sections include the following:
   1. Division 04 Section - Brick Masonry Unit.
   2. Division 04 Section - Concrete Masonry Unit.
   3. Division 04 Section - Cast Stone.
   4. Division 04 Section - Masonry Cleaning.
   5. Division 04 Section - Joint Sealers.

1.03 DEFINITIONS

A. Definitions contained in ASTM C 119 apply to this Section.

B. Dimension Stone Cladding System: An exterior wall covering system consisting of dimension stone panels together with the anchors, mortar, fasteners, and sealants used to secure the stone to the building structure and to produce a weather-resistant covering.

1.04 PERFORMANCE REQUIREMENTS

A. General: Design stone anchors and anchoring systems according to ASTM C 1242.

B. Structural Performance: Provide dimension stone cladding system capable of withstanding the effects of gravity loads.

C. Thermal Movements: Provide dimension stone cladding system that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing displacement of stone, opening of joints, overstressing of components, failure of joint sealants and connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime sky heat loss.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Safety Factors for Stone: Design dimension stone cladding system to withstand loads indicated without exceeding allowable working stress of stone determined by dividing stone's average ultimate strength, as established by testing, by the following safety factors:
   1. Safety Factors for Oolitic Limestone: According to ILI's "Technote on Safety Factors."
   2. Safety Factors for Dolomitic Limestone: 5 for uniform loads and 10 for concentrated loads.

E. Design stone anchors to withstand loads indicated without exceeding allowable working stresses established by the following:
   1. For Cold-Formed Stainless Steel: ASCE 8, "Specification for the Design of Cold-Formed Stainless Steel Structural Members."

2. For Cast-in-Place and Post-installed Fasteners in Concrete: One-fourth of tested capacity when installed in concrete with compressive strength indicated.

F. Provision for Deflection of Building Structure: Allow for the following:
   1. Deflection due to Weight of Dimension Stone Cladding System: Allow for 1/4-inch vertical deflection in 20-foot span of structural members supporting dimension stone cladding system.

G. Control of Corrosion and Staining: Prevent galvanic and other forms of corrosion as well as staining by isolating metals and other materials from direct contact with incompatible materials. Use materials that do not stain exposed surfaces of stone and joint materials.

1.05 SUBMITTALS

A. Product Data: For each variety of stone**,** stone accessory, and other manufactured products indicated.

B. Shop Drawings: Show details of fabrication and installation of dimension stone cladding system, including dimensions and profiles of stone units.
   1. Show locations and details of joints both within dimension stone cladding system and between dimension stone cladding system and other construction.
   2. Include details of mortar joints**,** and sealant joints.
   3. Show locations and details of anchors.

C. Stone Samples for Verification: Sets for each color, grade, finish, and variety of stone required; not less than 12 inches square. Include two or more Samples in each set showing the full range of variations in appearance characteristics expected in the completed Work.

D. Sealant Samples for Verification: For each type and color of joint sealant required.

E. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

F. Material Test Reports: From a qualified independent testing agency indicating and interpreting test results of the following for compliance with requirements indicated:
   1. Sealant Compatibility and Adhesion Test Report: From sealant manufacturer complying with requirements in Division 07 Section - Joint Sealants. Include interpretation of test results and recommendations for primers and substrate preparation needed for adhesion.
   2. Certification: Submit Certificates of Compliance indicating that stone material supplied for the work complies with requirements of these specifications.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed dimension stone cladding systems similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
   1. Installer's responsibilities include engineering, fabricating, and installing dimension stone cladding system.
   2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

B. 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 dimension stone cladding systems that are similar to those indicated for this Project in material, design, and extent.

C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

D. Source Limitations for Stone: Obtain each variety of stone, regardless of finish, from a single quarry with resources to provide materials of consistent quality in appearance and physical properties.

E. Obtain each variety of stone from a single quarry, whether specified in this Section or in another Section of the Specifications.

F. Source Limitations for Mortar Materials: Obtain mortar ingredients of uniform quality for each cementitious component from a single manufacturer and each aggregate from one source or producer.

G. Source Limitations for Other Materials: Obtain each type of stone accessory, sealant, and other material from a single manufacturer for each product.

H. Preconstruction Sealant Compatibility and Adhesion Testing: Submit to joint sealant manufacturer's samples of materials that will contact or affect joint sealants, for compatibility and adhesion testing according to sealant manufacturer's standard testing methods and Division 07 Section - Joint Sealants.

I. Pre-Installation Meeting: Convene a pre-installation meeting at least one week prior to commencing Work of this Section.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver sealants to Project site in original unopened containers labeled with manufacturer's name, product name and designation, color, expiration period, pot life, curing time, and mixing instructions for multi-component materials.

B. Store and handle stone and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, and other causes.
   1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move stone, if required, using dollies with cushioned wood supports.
   2. Store stone on wood skids or pallets with nonstaining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to stone. Ventilate under covers to prevent condensation.

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

D. Store aggregates in locations where grading and other required characteristics can be maintained and where contamination can be avoided.

1.08 PROJECT CONDITIONS

A. Cold-Weather Construction: Do not use frozen materials or materials mixed or coated with ice or frost. Remove and replace dimension stone cladding damaged by frost or freezing conditions. When ambient temperature is within limits indicated, use the following procedures:
   1. At 40 deg F and below, produce mortar temperatures between 40 and 120 deg F by heating mixing water and, at temperatures of 32 deg F and below, sand. In heating mortar materials, maintain mixing temperatures within 10 deg F; do not heat water to above 160 deg F. Maintain temperature of mortar on boards above freezing. Do not apply mortar to stone units or substrates below 32 deg F.

2. At 25 to 20 deg F, heat both sides of walls under construction. Use windbreaks or enclosures when wind velocity exceeds 15 mph.
3. At 20 deg F and below, provide enclosure and auxiliary heat to maintain air temperature above 32 deg F within enclosure. Heat stone so it is above 40 deg F at time of installation.

B. Cold-Weather Protection: When mean daily temperature is within limits indicated, provide the following protection:
1. 40 to 25 Deg F: Cover dimension stone cladding with a weather-resistant membrane for 48 hours after construction.
2. 25 to 20 Deg F: Cover dimension stone cladding with insulating blankets or provide enclosure and heat to maintain air temperature above 32 deg F within enclosure for 48 hours after construction. Use windbreaks or enclosures when wind velocity exceeds 15 mph.
3. 20 Deg F and below: Provide enclosure and heat to maintain air temperature above 32deg F within enclosure for 48 hours after construction.

C. Environmental Limitations for Sealants: Do not install sealants when ambient and substrate temperatures are outside limits permitted by sealant manufacturer or below 40 deg F or when joint substrates are wet.

PART 2 - PRODUCTS

2.01 STONE, GENERAL

A. Varieties and Sources: Subject to compliance with requirements, provide stone varieties from sources indicated.

B. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.

C. For each stone variety**,** provide matched blocks extracted from a single bed of quarry stratum unless Architect approves stone from blocks randomly selected for aesthetic effect.

D. Quarry stone in a manner to ensure that as-quarried block orientations yield finished stone with required characteristics.

E. Make quarried blocks available for examination by Architect for appearance characteristics.

2.02 STONE TYPES

A. Limestone: Provide limestone complying with ASTM C 568 and as follows:
1. Match existing limestone

2.03 STONE

A. Interior: Limestone as quarried by Mezger Enterprises, or equal. Stone shall conform to accepted range of color, pattern, and texture as approved by Architect, and as previously specified. Stone shall be Texas Smooth Limestone.
1. Stone Sizes: Standard Panel, 2’-7 ¾” x 1’-3 ¾”.
2. Stone Thickness: Stone veneer thickness shall be 1” thick panels with continuous kerf at top and bottom for attachment.
3. Attachment: Maintain a minimum of 1” clearance behind stone to any substrate.
4. Pattern: Stone shall be laid in half running bond as shown on drawings.
5. Joints: Joint width shall be ¼”.
6. Stone Color: Stone color shall be Texas Limestone as approved by the Architect and Owner.
7. Corners: Provide overlap at all outside corners, unless noted otherwise on the drawings.

B. Exterior: Limestone as quarried by Mezger Enterprises, or equal. Stone shall conform to accepted range of color, pattern, and texture as approved by Architect, and as previously specified. Stone shall be Texas Smooth Limestone.
   1. Stone Sizes: Standard Panel, 2'-7 ¾" x 1'-3 ¾".
   2. Stone Thickness: Stone veneer thickness shall be 3 1/2" thick panels with continuous reveal at top and bottom for attachment.
   3. Attachment: Maintain a minimum of 3" clearance behind stone to any substrate.
   4. Pattern: Stone shall be laid in half running bond as shown on drawings.
   5. Joints: Joint width shall be ¼".
   6. Stone Color: Stone color shall be Texas Limestone as approved by the Architect and Owner.
   7. Corners: Provide overlap at all outside corners, unless noted otherwise on the drawings.
   8.

C. All stone shall be cut accurately to shape and dimensions, with jointing as shown on approved drawings. All exposed faces shall be natural texture/culture with beds and joints dressed straight and square, unless otherwise shown. Except where required and noted on the drawings, joints shall have a uniform thickness of 3/8". Repair of defects or damage stone will be permitted according to industry standards.

D. Quality of stone and workmanship shall conform to the existing standards established by the Building Stone Institute. Bidders not familiar with the standards should inform themselves accordingly.

2.04 MORTAR MATERIALS

A. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207.

B. Aggregate: ASTM C 144; except for joints narrower than 1/4 inch and pointing mortar, use aggregate graded with 100 percent passing No. 16 sieve.

C. Water: Potable, non-staining.

D. Interior Stone to Cement Backer Board:
   1. Polymer modified thin-set: Laticrete; Product - 255 Multimax.

2.05 ANCHORS

A. Fabricate anchors, including shelf angles, from stainless steel, ASTM A 666, Type 304, temper as required to support loads imposed without exceeding allowable design stresses.
   1. Fasteners for Stainless-Steel Anchors: Annealed stainless-steel bolts, nuts, and washers; ASTM F 593 for bolts and ASTM F 594 for nuts, Alloy Group 1.
   2. Wire ties are not permitted.
   3. Anchor Plate: 0.0598 Stainless steel continuous anchor plate with 1in flange.
   4. Continuous double or single anchor at top and bottom of each panel. Provide ¼" neoprene space between anchor and substrate to allow for construction tolerances. Anchoring shall be into stud framing and minimum 16"o.c.

B. Cast-in-Place and Postinstalled Fasteners for Concrete and Masonry: Type indicated below, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
   1. Adjustable Inserts Embedded in Concrete: Steel, cast iron, or malleable iron, with bolts, nuts, washers, and shims; all hot-dip galvanized or mechanically zinc coated.
   2. Postinstalled Fasteners for Concrete and Masonry: Chemical anchors, torque-controlled expansion anchors, or undercut anchors made from stainless-steel components complying

with ASTM F 593 and ASTM F 594, alloy Group 1 or 2 for bolts and nuts; ASTM A 666 or ASTM A 276, Type 304 or 316, for anchors.

2.06 STONE ACCESSORIES

A. Setting Shims: Strips of resilient plastic or vulcanized neoprene, 50 to 70 Shore A durometer, nonstaining to stone, sized to suit joint thicknesses and depths of stone supports without intruding into required depths of joint sealants or causing third-side adhesion between sealant and setting shims.

B. Concealed Sheet Metal Flashing: Fabricate from stainless steel complying with requirements specified in Division 07 Section - Sheet Metal Flashing and Trim in thicknesses indicated, but not less than 0.0156 inch thick.

C. Dampproofing for Limestone: Provide cementitious formulations that are recommended by ILI and that are nonstaining to stone, compatible with joint sealants, and noncorrosive to anchors and attachments.

D. Cleaner:
   1. Commercial, neutral liquid type especially prepared for stone work, as recommended by stone fabricator.
   2. Ph Factor between 7 and 10.
   3. Free from crystallizing slats or water-soluble alkaline salts.
   4. Biodegradable and phosphate free.

E. Epoxy: As recommended by stone fabricator.

F. Stain prevention: Any of the following methods may be used if needed or required due to local conditions:
   1. Non-sealing, water repellent, applied after installation.
   2. Waterproof all concrete surfaces, shelf angles, etc., against which stone is to be applied.

G. Plastic Weep Vent: One-piece, flexible extrusion manufactured from ultraviolet-resistant polypropylene copolymer, designed to weep moisture in masonry cavity to exterior, in color selected from manufacturer's standard.

H. Sealant Products: Provide manufacturer's standard chemically curing, elastomeric sealants that are compatible with joint fillers, joint substrates, and other related materials and that comply with requirements in Division 07 Section - Joint Sealants for products corresponding to those indicated below:
   1. Sealant for Joints in Dimension Stone Cladding: As follows:
      a. Single-component, nonsag, urethane sealant.
   2. Generally use rigid sealant, such as high-modulus or traffic type, to provide even load transfer from stone to anchor.
   3. Verify suitability of sealant below before retaining. Silicone sealants often stain porous, light-colored stone.
   4. Colors: Provide colors of exposed sealants to comply with the following requirement:
      a. Match color of stone.

2.07 STONE FABRICATION

A. Fabrication Tolerances:
   1. Maximum Variation From Thickness: +/- 1/4 inch.
   2. Maximum Variation From Face Size: +/- 1/16 inch, non-cumulative.
   3. Maximum Variation From Flat: 1/8 inch or 1/3 of the specified joint width, whichever is greater.

B. General: Fabricate stone units in sizes and shapes required to comply with requirements indicated, including details on Drawings and Shop Drawings.

1. For limestone, comply with recommendations in ILI's "Indiana Limestone Handbook."

C. Cut and drill sinkages and holes in stone for anchors, fasteners, supports, and lifting devices as indicated or needed to set stone securely in place; shape beds to fit supports.

D. Cut stone to produce pieces of thickness, size, and shape indicated and to comply with fabrication and construction tolerances recommended by applicable stone association or, if none, by stone source, for faces, edges, beds, and backs.
   1. Minimum Thickness: Provide stone units of not less than the following thickness, unless otherwise indicated:
      a. Limestone: 1 inch.
   2. Control depth of stone and back check to maintain minimum clearances indicated between backs of stone units and surfaces or projections of structural members, fireproofing (if any), backup walls, and other work behind exterior stone.
      a. Minimum Clearance: 3 inches.
   3. Dress joints (bed and vertical) straight and at right angle to face, unless otherwise indicated. Make arises straight, sharp, true, and continuous at joints.
   4. Quirk-miter corners, unless otherwise indicated; provide for cramp anchorage in top and bottom bed joints of corner pieces.
   5. Cut stone to produce joints of uniform width and in locations indicated.
      a. Joint Width: 1/4 inch.
   6. Leave the following joints open for sealant:
      a. Head joints in top courses, including coping, parapets, cornices, sills and steps.
      b. Joints in projecting units.
      c. Joints between rigidly anchored units, including soffits, panels and column covers.
      d. Joints between lugged sills and stair treads.
      e. Joints below ledge and relieving angles.
      f. Joints labels “expansion joint”
   7. Clean backs of stone to remove rust stains, iron particles, and stone dust.

E. Slope exposed top surfaces of stone and horizontal sill surfaces for natural wash.

F. Drip Grooves: Provide at soffits and similar overhanging conditions where overhang is greater than 1/2”. Size slot not less than 3/8 inch wide and 1/4 inch deep; full width of projection.

G. Arises: Remove the sharp edge from arises to slightly blunt edge and to reduce chipping of the finished edge.

H. Contiguous Work: Provide chases, reveals, reglets, openings, and similar features as required to accommodate contiguous work.

I. Finish exposed faces and edges of stone to comply with requirements indicated for finish and to match approved samples.

J. Pattern Arrangement: Fabricate and arrange panels with veining and other natural markings to comply with the following requirements:
   1. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
   2. Arrange panels with veining to match existing.

K. Carefully inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.
   1. Grade and mark stone for overall uniform appearance when assembled in place. Natural variations in appearance are acceptable if installed stone units match range of colors and other appearance characteristics represented in approved samples and mockups.

2.08 MORTAR MIXES

A. General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortar of uniform quality and with optimum performance characteristics.
   1. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated. Do not use calcium chloride.
   2. Combine and thoroughly mix cementitious materials, water, and aggregates in a mechanical batch mixer, unless otherwise indicated. Discard mortar when it has reached initial set.

B. Portland Cement-Lime Setting Mortar: Comply with ASTM C 270, Proportion Specification, for types of mortar indicated below:
   1. Set limestone with Type N mortar.

C. Pointing Mortar: Comply with ASTM C 270, Proportion Specification, for types of mortar indicated. Provide pointing mortar mixed to match Architect's sample and complying with the following:
   1. Point limestone with Type N or Type S mortar.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine surfaces to receive dimension stone cladding and conditions under which dimension stone cladding will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of dimension stone cladding.
   2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Advise installers of other work about specific requirements for placement of inserts, flashing reglets, and similar items to be used by dimension stone cladding Installer for anchoring, supporting, and flashing of dimension stone cladding system. Furnish installers of other work with Drawings or templates showing locations of these items.

B. Protect dimension stone cladding during erection as follows:
   1. Cover tops of dimension stone cladding installation with nonstaining, waterproof sheeting at end of each day's work. Cover partially completed structures when work is not in progress. Extend cover a minimum of 24 inches down both sides and hold securely in place.
   2. Prevent staining of stone from mortar, grout, sealants, and other sources. Immediately remove such materials without damaging stone.
   3. Protect base of walls from rain-splashed mud and mortar splatter by coverings spread on ground and over wall surface.
   4. Protect sills, ledges, and projections from mortar and sealant droppings.

C. Clean stone surfaces that are dirty or stained by removing soil, stains, and foreign materials before setting. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

3.03 SETTING DIMENSION STONE CLADDING, GENERAL

A. Execute dimension stone cladding installation by skilled mechanics and employ skilled stone fitters at Project site to do necessary field cutting as stone is set.
   1. Use power saws with diamond blades to cut stone. Produce lines cut straight and true, with edges eased slightly to prevent snipping.

B. Contiguous Work: Provide reveals, reglets, and openings as required to accommodate contiguous work.

C. Set stone to comply with requirements indicated on Drawings and Shop Drawings. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure dimension stone cladding in place. Shim and adjust anchors, supports, and accessories to set stone accurately in locations indicated with uniform joints of widths indicated and with edges and faces aligned according to established relationships and indicated tolerances.

D. Provide expansion, control, and pressure-relieving joints of widths and at locations indicated.
   1. Keep expansion joints free of mortar and other rigid materials.

E. Install concealed flashing at continuous shelf angles, lintels, ledges, and similar obstructions to downward flow of water to divert water to building exterior.

F. Keep cavities open where unfilled space is indicated between back of stone units and backup wall; do not fill cavities with mortar or grout.
   1. Coat limestone cladding with dampproofing to extent indicated below:
      a. Stone at Grade: Beds, joints, and back surfaces to at least 12 inches above finish-grade elevations.
      b. Stone Extending below Grade: Beds, joints, back surfaces, and face surfaces below grade.
      c. Allow cementitious dampproofing formulations to cure before setting dampproofed stone. Do not damage or remove dampproofing while handling and setting stone.
   2. Place weep holes and vents in joints where moisture may accumulate, including base of cavity walls, above shelf angles, and flashing. Locate weep holes and vents at intervals not exceeding 24 inches and for those serving as vents only, at intervals not exceeding 60 inches horizontally and 20 feet vertically.

3.04 INSTALLATION TOLERANCES

A. Variation from Plumb: For vertical lines and surfaces of walls, do not exceed 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch in 40 feet or more. For external corners, corners and jambs within 20 feet of an entrance, expansion joints, and other conspicuous lines, do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 3/8 inch in 40 feet or more.

B. Variation from Level: For lintels, sills, water tables, parapets, horizontal bands, horizontal grooves, and other conspicuous lines, do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 3/8 inch maximum.

C. Variation of Linear Building Line: For positions shown in plan and related portions of walls and partitions, do not exceed 1/4 inch in 20 feet or 1/2 inch in 40 feet or more.

D. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated, do not exceed plus or minus 1/4 inch.

E. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch in 36 inches or a quarter of nominal joint width, whichever is less.

F. Variation in Plane between Adjacent Stone Units (Lipping): Do not exceed 1/16-inch difference between planes of adjacent units.

3.05 SETTING MECHANICALLY ANCHORED DIMENSION STONE CLADDING

A. Attach anchors securely to stone and to backup surfaces. Comply with recommendations in ASTM C 1242.

Fill anchor holes with sealant.

1. Where dowel holes occur at pressure-relieving joints, provide compressible material at ends of dowels.

B. Set stone supported on clip or continuous angles on resilient setting shims. Use material of thickness required to maintain uniform joint widths. Hold shims back from face of stone a distance at least equal to width of joint.

3.06 SETTING DIMENSION STONE CLADDING WITH MORTAR

A. Set stone in full bed of mortar with head joints slushed full, unless otherwise indicated.

1. Use setting buttons of adequate size, in sufficient quantity, and of thickness required to maintain uniform joint width and to prevent mortar from extruding. Hold buttons back from face of stone a distance at least equal to width of joint.
2. Do not set heavy units or projecting courses until mortar in courses below has hardened enough to resist being squeezed out of joint.
3. Support and brace projecting stones until wall above is in place and mortar has set.
4. Provide compressible filler in ends of dowel holes and bottoms of kerfs to prevent end bearing of dowels and anchor tabs on stone. Fill remainder of anchor holes with mortar.

B. Fill space between back of stone units and backup wall solidly with mortar or grout.

C. Embed ends of sills in mortar; leave remainder of joint open until final pointing.

D. Rake out joints for pointing with mortar to depths of not less than 1/2 inch. Rake joints to uniform depths with square bottoms and clean sides.

E. Prepare stone-joint surfaces for pointing with mortar by removing dust and mortar particles. Where setting mortar was removed to depths greater than surrounding areas, apply first layer of pointing mortar in layers not more than 3/8 inch until a uniform depth is formed; compact each layer thoroughly and allow to become thumbprint hard before applying next layer.

F. Point stone joints by placing and compacting pointing mortar in layers not more than 3/8 inch.

G. Tool joints with a round jointer having a diameter 1/8 inch larger than width of joint, when pointing mortar is thumbprint hard.

H. Set the following dimension stone cladding with unfilled head joints for installing joint sealants:

1. Cornices.
2. Copings.
3. Belt and other projecting courses.
4. Top course adjacent to soffit.

3.07 JOINT SEALANT INSTALLATION

A. Prepare joints and apply sealants of type and at locations indicated to comply with applicable requirements in Division 07 Section - Joint Sealants.

B. Joint Materials: Any of the following may be used:

1. Sealant-joints shall be an approved system including primer, gasket, and sealant with non-staining properties confirming to ASA specifications A116.1. Manufacturer's recommendations regarding handling, storing, application, and curing shall be followed.
2. Mortar-joints shall be type A or B setting mortar per setting mortars paragraph.

3. Expansion-joints shall be adequate to allow for thermal and structural differential movement. Filler material for these joints shall be non-staining and compatible with sealing compound.
4. Grout--shall be composed of one part non-staining Portland Cement and one and one-half parts fine sand, mixed in small quantities of as thick a consistency as can be poured into the joints. Grout shall be stirred vigorously until used.
5. Weeps-felt wick, mildew and fungus proofed, shall be place in joints where moisture may accumulate, such as base of cavity walls, continuous angles, flashing, etc.

3.08 ADJUSTING AND CLEANING

A. Remove and replace broken, chipped, stained, or otherwise damaged stone, defective joints, and dimension stone cladding that does not match approved samples. Damaged stone may be repaired if Architect approves methods and results.

B. Replace in a manner that results in dimension stone cladding's matching approved samples, complying with other requirements, and showing no evidence of replacement.

C. In-Progress Cleaning: Clean dimension stone cladding as work progresses. Remove mortar fins and smears before tooling joints.

D. Clean dimension stone cladding no fewer than six days after completion of pointing and sealing, using clean water and stiff-bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning agents containing caustic compounds or abrasives, or other materials or methods that could damage stone.

END OF SECTION 04 42 00

SECTION 04 42 50 - QUARRIED STONE BLOCK

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 large uniform blocks of shelf limestone, excavated and quarried on-site, for use in landscape applications as shown in plans and detailed in this specification.

1.03 SUBMITTALS

A. Photos: Show 6-10 individual photos of representative sample stones at the quarry. Each photo shall have a yardstick or tape measure to demonstrate general length, width and depth. Photos shall be taken in full sunlight to demonstrate range of color hues.

1.04 QUALITY ASSURANCE

A. Installer's Field Supervision: Require installer to maintain an experienced full-time supervisor on project site when stone work is in progress.

B. Source Limitations for Stone: Obtain stone from a single quarry.

1.05 RELATED DOCUMENTS AND REFERENCES

A. Drawings and general provisions of contract, including general and supplementary conditions and Division I specifications, apply to work of this section.

B. Related Specification Section
   1. 31 20 00 – EARTH MOVING (SUBGRADE PREPARATION)

1.06 VERIFICATION

A. All scaled dimensions on the drawings are approximate. Before proceeding with any work, the Contractor shall carefully check and verify all dimensions and quantities, and shall immediately inform the Owner's Representative of any discrepancies between the information on the drawings and the actual conditions, refraining from doing any work in said areas until given approval to do so by the Owner's Representative

PART 2 - PRODUCTS

2.01 LIMESTONE

A. Sources:
   1. Mezger Enterprises, PO Box 1553, Lampasas, TX 76550 254-547-8598, www.mezger.com, or approved equal.

B. Shapes and Sizes:
   1. Landscape Block
      a. Type A: 24" width, 18" height, by, 48" and 72" lengths unless noted otherwise, sawn on top, bottom, and only end surfaces and sides, remaining roughhewn splitface finish. Drill marks are acceptable. See photo below for representative example:

b. Top surface of stone block shall receive stone sealer.

2.02 SKATEBOARD GUARD

A. Basis of Design Product: Skateboard Deterrent for Flat Edge Benches, ANOVA Furnishings
   1. Dimensions 1 ¼" H x 1 ½" W x 2 ¼" L
   2. Aluminum
   3. Install where noted on plan

2.03 STONE SEALER

A. Basis Of Design Product: Sure Klean Natural Stone Treatment, Prosoco, Inc.
   1. 95% min. Water Absorption reduction by ASTM C67 and ASTM C140

B. Top surface of stone block shall receive stone sealer.

PART 3 - EXECUTION

3.01 SETTING STONE, GENERAL

A. Set stone to on a firm base with gravel, slope as shown in the drawings. Drawings show location of stone placement.

3.02 ADJUSTING AND CLEANING

A. Cleaning: Remove any soil remnants using a standard garden hose, brush or broom after positioning. Fine adjustments to the stone placement and positions shall be made prior to planting. Remove any soil remnants again when planting is complete.

END OF SECTION 04 42 50

SECTION 04 43 00 - STONE MASONRY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Provide stone exterior wall material, laid up like masonry, as shown on the Drawings and as specified herein.

B. Related Sections include the following:
   1. Division 05 Section - Steel Lintels, loose.
   2. Division 07 Section - Flashing, Sheet Metal.
   3. Division 07 Section - Sealants.

1.03 SUBMITTALS

A. Submit shop drawings per requirements of Division 01 Section, showing layout and details of construction, anchors, jointing and setting.

B. Submit three 12" x 12" samples of each type of finish of stone specified, showing full range of colors, for approval by Architect.

C. Copies of complete data on stone fabricator. Architect reserves the right to reject the fabricator if adequate past experience in the production of the types of units specified is not assured by the data submitted.

D. Copies of supplier's specifications and test data for type of stone required, including certification that stone complies with the specified requirements. Include instructions for handling, storage, installation and protection of stone.

E. Copies of complete data showing all colors, textures and finishes available.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Store materials in a dry place, above ground on level platforms. Cover and protect units as necessary from elements.

1.05 JOB CONDITIONS

A. Coordinate stonework with other trades whose work relates to this section, in any manner, for placing of all required backing, blocking and leave-outs, etc.

B. Masonry work shall not be placed when there is any possibility of the water freezing before it has attained its initial set. In weather below freezing, all masonry units and mortar shall be heated. Walls which have frozen after making their initial set shall not be built upon until they have had sufficient time to make a proper set at temperatures above freezing.

C. All newly placed masonry shall be protected against damage from action of the elements and under no condition shall rain be allowed to fall on, drive against or flow down masonry surfaces until mortar has set a minimum of 12 hours. Tops of all walls shall be covered with a waterproof material at the end of each day.

D. All newly placed stone shall be protected from damage of any sort.

1.06 QUALITY ASSURANCE

A. Qualification of fabricator: Obtain each stone from single quarry source, with accepted color range and texture throughout the work as established by approved samples.

B. Sources or kinds of materials as approved shall not be changed during course of work.

C. Stone fabricator shall have successfully fabricated work similar to quality specified in quantity shown for period of not less than 5 years.

D. Stone fabricator shall have been engaged in the business of fabricating stone specified for a period of not less than (5) years. Provide reference including project name, project architect and General Contractor.

E. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
   1. ASTM C 97, Absorption and Bulk Specific Gravity of Natural Building Stone
   2. ASTM C 99, Modulus of Rupture of Natural Building Stone
   3. ASTM C 170, Compressive Strength of Natural Building Stone.
   4. Masonry Institute of America Handbook for Marble & Stone Slab Veneer.

F. Pre-Installation Meeting: Convene a pre-installation meeting at least one week prior to commencing Work of this Section.

1.07 DELIVERY, STORAGE & HANDLING

A. Delivery of Materials:
   1. Carefully pack and unload stone with necessary caution to avoid damaging or soiling stone.
   2. Deliver stone in original package or pallets, plainly marked with identification of materials and manufacturer.

B. Storage of Materials:
   1. Store stone clear of the ground on non-staining skids made of non-chemically treated wood or of wood not containing tannin.
   2. Cover stone on all sides and bottom with waterproof paper, clean canvas or polyethylene.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All stone shall be standard grade, free from cracks, seams or other imperfections which might impair its structural integrity and finish. All stone furnished must conform to and be within the range of approved samples. Cut accurately to shape and dimensions shown on final shop drawings. Variations on surfaces from true plane shall not exceed 1/8" for smooth finish.

B. Stone:
   1. Color, texture and finish within range of samples approved by Architect.
   2. Limestone:
      a. Source: Mezger Enterprises
         PO Box 1553
         Lampasas, TX 76550
         254-547-8598
      b. Color: Cordova Cream
      c. Finish: Honed Finish
   3. Complying with ASTM C 568, Category II (medium density)

4. Minimum compression strength 4000 psi per ASTM C170 and maximum absorption 7.5% per ASTM C 97
5. Sizes:
   a. 2'-7 ¾" x 1'-3 ¾" x 3 ½".
   b. (Shelf Size) Mitered pieces to be done in the field.

C. Materials and Finishes: Match accepted samples approved by Architect.

2.02 ACCESSORIES

A. Anchors: Aluminum - 6061 - T6 - Kynar 500 Coating

B. Spacers: Impact resistant plastic (1/4" max. thickness)

C. Flashings: Stainless Steel Sheet: ASTM A 240 / A240M or ASTM A 666, type 304, dead soft, fully annealed.

D. Joint Sealers: Specified in Division 07 Section.

E. Cleaning Solution: type that will not harm stone, joint material, or adjacent surfaces.

2.03 FABRICATION

A. Cut adjacent pieces from same block wherever possible.

B. Provide kerf slot in top and bottom of panels.

C. Form stone corners to miter kerf joint profile.

D. Anchorage:
   1. Space anchors at maximum 24 inches on center and around perimeter.
   2. Minimum number of anchors: four per panel.

E. Fabrication Tolerances
   1. Variation in width or height: plus or minus 1/8 inch
   2. Variation in thickness: plus or minus 1/8 inch
   3. Variation in form true plane: plus or minus 1/16 inch in 3 feet

PART 3 - EXECUTION

3.01 INSPECTION

A. Inspect foundations to assure surfaces to support masonry are to proper grades and elevations, free of dirt or uneven surfaces. Examine all subsurfaces to receive stone work. Report in writing to General Contractor, with a copy to Architect, any conditions which may prove detrimental to the work. Commencement of work will be construed as acceptance of all subsurfaces.

3.02 PREPARATION

A. Establish lines, levels and coursing. Protect from disturbance.

B. Clean stone prior to installation. Do not use wire brushes or implements that can mark or damage exposed surfaces.

C. Wet absorptive stone in preparation for placement to minimize moisture suction from mortar.

3.03 STONE INSTALLATION

A. Install in accordance with American Limestone Co., Dallas, TX (214) 747-2636 ALC-2000 Veneer System Manual.

B. Arrange stone pattern to provide color uniformity and constant joint sizes throughout.

C. Set stone plumb and level. Align adjacent pieces in same plane.

D. All anchors shall be concealed.

E. Coordinate with other trades for placement of inserts and anchors. Provide templates or drawings as required.

F. Execute work with skilled mechanics and employ skilled fitters at site to do necessary field cutting as stone is set.

G. Provide openings and other spaces as shown or required for contiguous work. Close up openings in stone after other work is in place. Use materials and set to match surrounding work.

H. Set stone in accordance with final shop drawings.

I. Have all work done by competent stone masons and to appearance approved by Architect.

J. Remove and replace damaged or defective stonework to match adjacent acceptable stonework.

3.04 FLASHINGS AND WEEP HOLES

A. All flashings installed in accordance with herein specified requirements and in accordance with manufacturer's recommendations so that all flashing work pro-perly drains water to the outside.

B. Provide smooth mortar beds, slightly pitched to the outside face of the wall at all points where flashings are to be installed over horizontal surfaces.

C. Flashing shall extend beyond outside face of wall as detailed on drawings.

D. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends, turn up and fold not less than 2 inches to create a folded end dam, per manufacturers recommendations & literature

E. Install weep vents in vertical joint of first course above flashings at 24" o.c.

F. Flashing to be installed with top edge extending behind sheathing as detailed on drawings.

3.05 CONTROL & SOFT JOINTS

A. Make adequate provisions throughout the stone work for expansion and contraction. Install preformed control joint gasket, extending from top of bearing surface to top of wall, reinforcing shall not run through.

B. Install soft joint material at top of stone.

3.06 SEALED JOINTS

A. Outside joints at the perimeter of exterior door and window frames shall not be less than 1/4" nor more than 3/8" wide and shall be cleaned out to a uniform depth of at least 3/4" for sealant, provided under Division 07 Section.

3.07 BUILT-IN WORK

A. Contractor shall carefully examine architectural and mechanical drawings providing all slots, chases, recesses in masonry work as required. No pipes shall be enclosed unless tested.

3.08 INSTALLATION TOLERANCES

A. Maximum variation from level and plumb: 1/8 inch in 10 feet, noncumulative.

B. Maximum variation in plane between adjacent pieces as joint: Plus or minus 1/16 inch.

3.09 CLEANING

A. Clean stone with stiff brushes and water.

B. If initial cleaning does not produce acceptable results, apply cleaner in accordance with manufacturer's instructions
   1. Prior to applying, clean sample panel in area as directed by Architect. If approved, use same materials and techniques for cleaning remainder of stone.
   2. Protect adjacent surfaces.
   3. Wet stone prior to applying cleaner.
   4. Thoroughly rinse surfaces with water after completion of cleaning: remove all traces of cleaning solution.

3.10 PROTECTION

A. Protect stonework from soiling and damage during all phases of construction.

END OF SECTION 04 43 00

SECTION 04 81 00 - UNIT MASONRY ASSEMBLIES

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 unit masonry assemblies consisting of the following:
   1. Concrete masonry units (CMU's).
   2. Face brick.
   3. Mortar and grout.
   4. Reinforcing steel.
   5. Masonry joint reinforcement.
   6. Ties and anchors.
   7. Embedded flashing.
   8. Miscellaneous masonry accessories.

B. Related Sections include the following:
   1. Division 07 Section - Fluid Applied Membrane Air Barriers for membranes applied to exterior face of gypsum sheathing at exterior masonry cavity walls.
   2. Division 07 Section - Bituminous Dampproofing for dampproofing applied to cavity face of backup wythes of cavity walls.
   3. Division 07 Section - Flashing and Sheet Metal for exposed sheet metal flashing.
   4. Division 07 Section - Firestopping for firestopping at openings in masonry walls.
   5. Division 07 Section - Joint Sealants for sealing control and expansion joints in unit masonry.
   6. Division 07 Section - Building Insulation for cavity wall insulation.

C. Products furnished, but not installed, under this Section include the following:
   1. Dovetail slots for masonry anchors, installed under Division 03 Section - Cast-in-Place Concrete.
   2. Anchor sections of adjustable masonry anchors for connecting to structural frame, installed under Division 05 Section - Structural Steel.

D. Products installed, but not furnished, under this Section include the following:
   1. Steel lintels and shelf angles for unit masonry, furnished under Division 05 Section - Metal Fabrications.
   2. Manufactured reglets in masonry joints for metal flashing, furnished under Division 07 Section - Sheet Metal Flashing and Trim.

1.03 DEFINITIONS

A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.04 SUBMITTALS

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

B. Shop Drawings: For the following:
   1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
   2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.

3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Verification: For each type and color of the following:
   1. Face brick, in the form of straps of five or more bricks.
   2. Concrete Masonry Units: full size soap or block sample for each color and finish other than standard CMU.
   3. Pigmented and colored-aggregate mortar. Make Samples using same sand and mortar ingredients to be used on Project. Label Samples to indicate types and amounts of pigments used.
   4. Weep holes/vents.
   5. Accessories embedded in masonry.

D. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
   1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

E. Qualification Data: For testing agency.

F. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:
   1. Masonry units.
      a. Include material test reports substantiating compliance with requirements.
      b. For bricks, include size-variation data verifying that actual range of sizes falls within specified tolerances.
      c. For exposed brick, include material test report for efflorescence according to ASTM C 67.
      d. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
   2. Cementitious materials. Include brand, type, and name of manufacturer.
   3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
   4. Grout mixes. Include description of type and proportions of ingredients.
   5. Reinforcing bars.
   6. Joint reinforcement.
   7. Anchors, ties, and metal accessories.

G. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
   1. Include test reports, per ASTM C 780, for mortar mixes required to comply with property specification.
   2. Include test reports, per ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

H. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.05 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1093 for testing indicated, as documented according to ASTM E 548.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients for each type exposed unpainted masonry of a uniform quality, including color, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.

D. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Payment for these services will be made by Owner. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
   1. Prism Test: For each type of construction required, per ASTM C 1314.

E. Sample Panels: Build up to three sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects. Comply with requirements in Division 01 Section - Quality Requirements for mockups.
   1. Build sample panels for each type of exposed unit masonry construction at in sizes approximately 84 inches by 60 inches high by full thickness.
   2. Protect approved sample panels from the elements with weather-resistant membrane.
   3. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.
      a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless such deviations are specifically approved by Architect in writing.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section - Project Management and Coordination.

1.06 DELIVERY, STORAGE, AND HANDLING

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

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

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

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

1.07 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
   1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.

2. Where 1 wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
   1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
   2. Protect sills, ledges, and projections from mortar droppings.
   3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
   4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
   1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

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

PART 2 - PRODUCTS

2.01 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not uses units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.02 CONCRETE MASONRY UNITS (CMU'S)

A. Shapes: Provide shapes indicated and as follows:
   1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, partial height wall caps, bonding, and other special conditions.
   2. Provide custom shapes for all outside corners that are not 90 degrees.
   3. Where burnished CMU units are shown to have exposed burnished ends, tops, or double sided burnished finish, provide units with additional factory burnished faces.
   4. Provide bullnose units at all exposed interior outside corners of finished CMU walls
      a. Bullnoses may be site-tooled for standard and burnished block provided mockups for site tooling and finishing are approved by Architect.
      b. Provide square-edged units for other outside corners, unless otherwise indicated.

B. Concrete Masonry Units: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi.
2. Weight Classification: Normal weight, unless otherwise indicated.
3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

2.03 MASONRY LINTELS

A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam concrete masonry units with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.04 BRICK

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

B. Face Brick: ASTM C 216, Grade MW or SW, Type FBS.
   1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3000 psi.
   2. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested per ASTM C 67.
   3. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
   4. Application: Use where brick is exposed, pattern as indicated on the drawings, unless otherwise indicated.
   5. Products: Re-use salvaged brick to patch and repair areas of brick façade disturbed by construction.

2.05 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color cement with pigments as required to produce mortar color indicated:

B. Hydrated Lime: ASTM C 207, Type S.

C. Workability Additive (Face Brick only): "A" Marble Dust by Armco Steel Corp., 90/200 Mineral Filler by Limestone Products.

D. Aggregate for Mortar: ASTM C 144.
   1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
   2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.

E. Aggregate for Grout: ASTM C 404.

F. Water: Potable

2.06 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.
   1. Interior Walls: Hot-dip galvanized, carbon steel.
   2. Exterior Walls: Hot-dip galvanized, carbon.
   3. Wire Size for Side Rods: 0.187-inch diameter.
   4. Wire Size for Cross Rods: 0.148-inch diameter.
   5. Wire Size for Veneer Ties: 0.187-inch diameter.
   6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
   7. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

D. Masonry Joint Reinforcement for Multiwythe Masonry:
   1. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches. Size ties to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face.
   2. Available products:
      a. Dur-O-Wall; Truss design DA3700 Dur-O-Eye.
      b. Wire-Bond; Series 900 Level Hook and Eye Truss.

E. Use reinforcing ladders one size smaller than nominal block size, or as directed by Manufacturer, at helmholtz resonator acoustical blocks.

2.07 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in subsequent paragraphs that are made from materials that comply with subparagraphs below, unless otherwise indicated.
   1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153/A 153M, Class B-2 coating.

B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.

C. Adjustable Anchors for Connecting to Structure: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
   1. Connector Section for Concrete: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.053-inch- thick, steel sheet, galvanized after fabrication.

D. Adjustable Masonry-Veneer Anchors at metal studs
   1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
      a. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.
   2. Masonry Anchors for Uncoursed or Random Coarsed Stone Masonry at CMU Back-up: Galvanized ties that are bent in the form of triangular loops designed to be attached to

masonry joint reinforcement with vertical wires passing through ties and through eyes projecting from masonry joint reinforcement.
   a. System provides for vertical adjustment for stone pattern indicated in Division 04, Section “Stone Masonry”.
   b. Available Products:
      1) Hohmann & Barnard, Inc,; HVR-295 V.
      2) Wire Bond; Stone Tab Ladder.
3. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.
   a. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, and having slotted holes for inserting vertical legs of wire tie specially formed to fit anchor section.
   b. Fabricate sheet metal anchor sections and other sheet metal parts from 0.067-inch-thick, steel sheet, galvanized after fabrication.
   c. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.188-inch-diameter, hot-dip galvanized steel wire.
   d. Available Products: Basis of Design Product**[s]** are:
      1) For Coursed Masonry: Hohmann & Barnard, Inc.; X-Seal Anchor with X-Seal Tape.
4. Stainless-Steel Drill Screws for Steel Studs: Proprietary fastener consisting of carbon-steel drill point and 300 Series stainless-steel shank, complying with ASTM C 954 except manufactured with hex washer head and neoprene washer, No. 10 diameter by length required to penetrate steel stud flange with not less than three exposed threads.
   a. Available Products:
      1) Dayton Superior Corporation, Dur-O-Wal Division; Stainless Steel SX Fastener.
      2) ITW Buildex; Scots long life Teks.

2.08 EMBEDDED FLASHING MATERIALS

A. Flexible Flashing (Copper Composite): For flashing not exposed to the exterior, use the following, unless otherwise indicated:
   1. Copper-Laminated Flashing: 3-oz./sq. ft. copper sheet. Extend flashing past face of brick and trim flush after inspection.
      a. Product:
         1) York Manufacturing, Inc.; York Copper Fabric Flashing, “Multi-Flash 500”.

B. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

C. Termination bars: Provide stainless steel termination bars in cavity walls where copper flashing will be installed with termination bars to concrete block backup and with asphaltic felts stripped in to protect top side of terminations (refer to Division 07 "Bituminous Dampproofing").

2.09 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Weep/Vent Products:
   1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.
      a. Available Products:
         1) Advanced Building Products Inc.; Mortar Maze weep vent.
         2) Dayton Superior Corporation, Dur-O-Wal Division; Cell Vents.
         3) Heckmann Building Products Inc.; No. 85 Cell Vent.
         4) Hohmann & Barnard, Inc.; Quadro-Vent.
         5) Wire-Bond; Cell Vent.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
   1. Provide one of the following configurations:
      a. Strips, full-depth of cavity and 10 inches wide, with dovetail shaped notches 7 inches deep that prevent mesh from being clogged with mortar droppings.
      b. Strips, not less than 1-1/2 inches thick and 10 inches wide, with dimpled surface designed to catch mortar droppings and prevent weep holes from being clogged with mortar.
   2. Available Products:
      a. Advanced Building Products Inc.; Mortar Break II.
      b. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
      c. Mortar Net USA, Ltd.; Mortar Net.

F. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.142-inch steel wire, hot-dip galvanized after fabrication. Provide units with either two loops or four loops as needed for number of bars indicated.
   1. Available Products:
      a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
      b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
      c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
      d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

2.10 MASONRY-CELL INSULATION

A. Cellular plastic foam insulation comprised of spray-dried polymeric resin and a foaming catalyst concentrate which are combined with water and then injected, along with compressed air, into the wall cavity by the installer. Subject to compliance with requirements, provide CoreFoam as manufactured by cfiFOAM, Inc, or approved equal:
   1. ASTM E-84 Surface Burning Characteristics
      a. Flame Spread 25 or less.
      b. Smoke Generated less than 450.
      c. Thickness 3.5 inches (maximum test thickness)
      d. Flammability Classifications: Class A
   2. R-value 4.0-5.0 (hr ft^2 ˚F in)/BTU; 4.92 per inch at 25 ˚F.
   3. Density upon final curing: 0.5-1.0 lb / ft^3.
   4. Install in all cells of exterior walls between conditioned space and building exterior, except for grouted cells.
      a. At acoustical block, provide block with grout shields behind the acoustical fill material.

B. Molded-Polystyrene Insulation Units: Rigid, cellular thermal insulation formed by the expansion of polystyrene-resin beads or granules in a closed mold to comply with ASTM C

578, Type I. Provide total a R-value of 7.6. Provide specially shaped units designed for installing in cores of masonry units.

1. Available Products:
   a. Concrete Block Insulating Systems; Korfil.
   b. Shelter Enterprises Inc.; Omni Core.

2.11 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned. The use of muriatic acid is prohibited.
   1. Available Manufacturers:
      a. Diedrich Technologies, Inc.
      b. EaCo Chem, Inc.
      c. ProSoCo, Inc.
   2. Do not use materials or methods that can damage masonry finishes. Use only manufacturer's approved products and methods.

2.12 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
   1. Do not use calcium chloride in mortar or grout.
   2. Limit cementitious materials in mortar to portland cement and lime.
   3. Limit cementitious materials in mortar for exterior masonry to portland cement and lime.
   4. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
   1. For masonry below grade or in contact with earth, use Type S.
   2. For reinforced masonry, use Type S.
   3. For mortar parge coats, use Type S.
   4. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
   5. Use workability additive for brick masonry.
   6. Match existing mortar color for brick construction infill.

C. Grout for Unit Masonry: Comply with ASTM C 476.
   1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
   2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

2.13 SOURCE QUALITY CONTROL

A. Owner will engage a qualified independent testing agency to perform source quality-control testing indicated below:
   1. Payment for these services will be made by Owner.

2. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.

B. Clay Masonry Unit Test: For each type of unit furnished, per ASTM C 67.

C. Concrete Masonry Unit Test: For each type of unit furnished, per ASTM C 140.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
   1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
   2. Verify that foundations are within tolerances specified.
   3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

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

3.02 INSTALLATION, GENERAL

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

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

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

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed. Do not install any cut units at corner conditions.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
   1. Mix units from several pallets or cubes as they are placed.

F. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying. Do not wet CMU.

G. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:
   1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
   2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
   3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
   4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.

5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.
7. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.03 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar, unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

H. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.
   1. Install compressible filler in joint between top of partition and underside of structure above.
   2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c., unless otherwise indicated.
   3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
   4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Division 07 Section - Fire-Resistive Joint Systems.

3.04 MORTAR BEDDING AND JOINTING

A. Lay hollow brick and concrete masonry units as follows:
   1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
   2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.

3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Mortar joints to be tooled, except special joints as detailed.

3.05 CAVITY WALLS

A. Bond wythes of cavity walls together using one of the following methods:
1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 1.77 sq. ft. of wall area spaced not to exceed 16 inches o.c. horizontally and 16 inches o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches of openings and space not more than 36 inches apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches o.c. vertically.
   a. Where bed joints of wythes do not align, use adjustable (two-piece) type ties.
   b. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type ties to allow for differential movement regardless of whether bed joints align.
2. Masonry Joint Reinforcement: Installed in horizontal mortar joints.
   a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
   b. Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement.
   c. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type reinforcement to allow for differential movement regardless of whether bed joints align.

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

C. Coat cavity face of backup wythe to comply with Division 07 Section - Bituminous Dampproofing. Where indicated on drawings.

D. Membrane Dampproofing: Re: Division 07 Section - Self Adhering Sheet Dampproofing.

3.06 CONCRETE MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.
   a. Reinforcement above is in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.07 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to wall framing or concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:
   1. Fasten screw-attached anchors through sheathing to wall framing and to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
   2. Insert slip-in anchors in metal studs as sheathing is installed. Provide one anchor at each stud in each horizontal joint between sheathing boards.
   3. Embed tie sections in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and face of sheathing.
   4. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
   5. Space anchors as indicated, but not more than 16 inches o.c. vertically and 16 inches o.c. horizontally, with not less than 1 anchor for each 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.
   6. Provide self-sealing tape to seal around shaft of screw and legs of anchor at the point of penetration.

3.08 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry as follows using one of the following methods:
   1. Fit bond-breaker strips into hollow contour in ends of concrete masonry units on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
   2. Install preformed control-joint gaskets designed to fit standard sash block.
   3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
   4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

C. Form expansion joints in brick made from clay or shale as follows:
   1. Build in compressible joint fillers where indicated.
   2. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Division 07 Section - Joint Sealants.

D. Location of expansion joints:
   1. At long walls no greater than 25 feet maximum.
   2. At offsets in walls.
   3. Near corners (10 ft. maximum).
   4. At intersections of walls.
   5. Where short runs of masonry intersect long runs of masonry.
   6. Where materials of different coefficients of thermal expansion are joined.

E. Form open joint full depth of brick wythe and of width indicated, but not less Provide horizontal, pressure-relieving joints by inserting a compressible filler of width required for

installing sealant and backer rod specified in Division 07 Section - Joint Sealants, but not less than 3/8 inch.

1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.09 LINTELS

A. Install steel lintels where indicated.

B. Provide masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

3.10 FLASHING, WEEPS, CAVITY DRAINAGE, AND VENTS

A. General: Install embedded flashing and weeps in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at 2'-0" on center at top of masonry walls shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated. Embed flashing in manufacturer's recommended sealant. Seal lap joints as recommended by manufacturer.

B. Install flashing as follows, unless otherwise indicated:
   1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
   2. At multi-wythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches, and through inner wythe to within 1/2 inch of the interior face of wall in exposed masonry. Where interior face of wall is to receive furring or framing, carry flashing completely through inner wythe and turn flashing up approximately 2 inches on interior face.
   3. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, up face of sheathing at least 8 inches, through sheathing and up back of sheathing a minimum of 4 inches.
   4. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends, turn up and fold not less than 2 inches to create a folded end dam, per manufacturers recommendations & literature.
   5. Cut flexible flashing off flush with face of wall after masonry wall construction is completed and reviewed by architect.

C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

D. Install weeps in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
   1. Use specified weep/vent products to form weeps.
   2. Form weeps above flashing under brick sills.
   3. Space weeps 24 inches o.c., unless otherwise indicated.

E. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in Part 2 "Miscellaneous Masonry Accessories" Article. At a minimum, place Mortar Net to a height equal to the height of the first course, but not less than 8 inches. Place immediately above the top of flashings embedded in the wall, as masonry construction progresses, to catch mortar droppings and to maintain drainage.

F. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent products to form vents.
   1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

G. Install sill sealer at sill plate per manufacturer's written instructions.

3.11 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
   1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
   2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
   1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
   2. Limit height of vertical grout pours to not more than 60 inches.

3.12 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
   3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
   4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
   5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
   6. Where required clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

7. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.13 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
   1. Crush masonry waste to less than 4 inches in each dimension.
   2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Division 31 Section - Earthwork.
   3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

END OF SECTION 04 81 00

SECTION 051200 - STRUCTURAL STEEL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

1. Structural steel framing members and connections.
2. Deck support angles.
3. Shop prime painting and touch up painting in the field.
4. Temporary construction bracing.
5. Fabrication and erection inspection and testing.

B. Related Sections include the following:

1. Division 1 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
2. Division 1 Section “Submittals” for administrative requirements for the submission of shop drawings and other submittals.
3. Division 5 Section “Architecturally Exposed Structural Steel.
4. Division 5 Section "Steel Deck" for field installation of shear connectors.
5. Division 5 Section "Metal Fabrications" for steel lintels or shelf angles not attached to structural-steel frame miscellaneous steel fabrications and other metal items not defined as structural steel.
6. Division 5 Section “Metal Stairs”.

1.03 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC's "Code of Standard Practice for Steel Buildings and Bridges," that support design loads.

1.04 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand ASD-service loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using schematic details indicated and AISC's " Steel Construction Manual, edition as referenced in the Building Code.
2. Engineering Responsibility: Fabricator's responsibilities include using a qualified professional engineer to prepare structural analysis data for structural-steel connections.

B. Construction: Type PR, partially restrained.

1.05 SUBMITTALS

A. Submit in accordance with Division 1 Section “Submittals”.

B. Submittals for Review

1. Provide complete details and schedules for fabrication and shop assembly of members, erection plans, details, procedures, and diagrams showing sequence of erection of structural steel components.

    a. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
    b. Include embedment drawings.
    c. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
    d. Indicate type, size, and length of bolts, distinguishing between shop and field bolts.

2. Shop drawings and erection drawings shall not be made by using reproductions of Contract Drawings.

3. Structural steel members for which shop drawings have not been reviewed shall not be fabricated. Engineer's review shall cover general locations, spacings, and details of design. Omission from shop drawings of any materials required by the Contract Documents shall not relieve the Contractor of the responsibility of furnishing and installing such materials, even though such shop drawings may have been reviewed and returned.

C. Submittals for Information:

1. Product Data: For each type of product indicated.
2. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
3. Connection Calculations: Contractor shall design all connections not specifically detailed on the Drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Texas. Submit design calculations for the connections designed by the contractor, prior to or with the steel shop drawings. Shop drawings containing connections for which calculations have not been received shall be returned unchecked as an incomplete submittal. Calculations shall be retained for the Engineer's file and will not be approved or returned.

    a. Connections shall be designed in accordance with the requirements specified in the Structural Drawings and Specifications.
    b. Beam connections: Submit a complete calculation for each different beam connection used and detailed on the shop drawings. Conditions which are similar may be grouped together so as to utilize a single connection design.
    c. Submit complete connection calculations for wind brace connections, truss connections, moment connections and other connections where specified on the Contract Drawings. Each calculation shall identify the location or locations for which the connection applies, the member mark(s) from the Contract Documents, the piece mark(s) from the shop drawings, the member size, the design loading(s), member size, and the end of the member to which the connection applies.
    d. The unit of measurement for the connection calculations must follow the United States customary system (USCS).

4. Welding certificates.
5. Qualification Data: For Installer, fabricator, and testing agency.
6. Mill Test Reports: Signed by manufacturers certifying that the following products comply with requirements:

a. Structural steel including chemical and physical properties.
b. Bolts, nuts, and washers including mechanical properties and chemical analysis.
c. Shear stud connectors.
d. Shop primers.
e. Nonshrink grout.

7. Source quality-control test reports.

1.06 QUALITY ASSURANCE

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

B. Fabricator Qualifications: Company specializing in performing the work of this section with minimum 10 years of documented experience.

C. Fabricator Qualifications: The special inspector shall verify that the fabricator maintains detailed fabrication and quality control of the workmanship and the fabricator's ability to conform to approved construction documents and referenced standards. The special inspector shall review the procedures for completeness and adequacy relative to the code requirements for the fabricators scope of work
   1. Exception: Special inspections shall not be required where the work is done on the premises of a fabricator that is enrolled in a nationally accepted inspections program acceptable to the registered design professional in responsible charge. At completion of fabrication, the approved fabricator shall submit a certificate of compliance to building official upon request and to the registered design professional in responsible charge stating that the work was performed in accordance with the approved construction documents.

D. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

E. The latest adopted edition of all standards referenced in this Section shall apply unless noted otherwise. In case of conflict between these Contract Documents and the referenced standard, the Contract Documents shall govern. In case of conflict between these Contract Documents and the Building Code, the more stringent shall govern.

F. The Contractor shall furnish fabrication and erection inspection and testing of all welds in accordance with AWS D1.1, Chapter 6. Submit records of inspections and tests to the Owner's testing laboratory for their review. The fabrication and erection inspectors shall be AWS certified welding inspectors.

G. All materials, fabrication procedures and field erection are subject to verification inspection and testing by the Owner's testing laboratory in both the shop and field. Such inspections and tests will not relieve the Contractor of the responsibility for providing materials and fabrication procedures in compliance with specified requirements.

H. Qualifications for Welding Work: Contractor shall be responsible for qualifying welding operators in accordance with the AWS "Standard Qualification Procedure." Provide certification to Owner's testing laboratory that welders to be employed in the work have satisfactorily passed AWS qualification tests. Recertification of welders shall be Contractor's responsibility.

I. Qualification of Welding Procedures: Contractor shall provide the testing laboratory with welding procedures which are to be used. Welding procedures shall be qualified prior to use in accordance with AWS D1.1, Part B.

J. Comply with applicable provisions of the following specifications and documents:

1. AISC's "Code of Standard Practice for Steel Buildings and Bridges”
2. AISC's "Specification for Structural Steel Buildings."
3. ASTM A6 "Specifications for General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use."
4. AISC's "Specification for the Design of Steel Hollow Structural Sections."
5. RCSC's "Specification for Structural Joints Using High Strength Bolts."
6. AWS D1.1 "Structural Welding Code"
7. SSPC (Society for Protective Coatings), standards as noted.

K. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.

1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
2. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.08 COORDINATION

A. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.01 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992.

B. Channels, Angles: ASTM A 36.

C. Plate and Bar: ASTM A 36.

D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.

E. Steel Pipe: ASTM A 53, Type E, Grade B.

1. Weight Class: As indicated.
2. Finish: Black, except where indicated to be galvanized.

F. Welding Electrodes: Comply with AWS requirements.

2.02 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM F3125, grade A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.

1. Finish: Plain.

B. High-Strength Bolts, Nuts, and Washers: ASTM A 490, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers, plain.

C. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.

D. Unheaded Anchor Rods: ASTM F 1554, Grade 36.

1. Configuration: Straight.
2. Nuts: ASTM A 563 hex carbon steel.
3. Plate Washers: ASTM A 36/A 36M carbon steel.
4. Washers: ASTM F 436 hardened carbon steel.
5. Finish: Plain.

E. Threaded Rods: ASTM A 193.

1. Nuts: ASTM A 563hex carbon steel.
2. Washers: ASTM A 36 carbon steel.
3. Finish: Plain.

F. Adhesive Anchors:
1. In concrete:
   a. HIT RE 500V3-Safe Set System, Hilti Inc.
   b. SET-XP epoxy, Simpson Strong-Tie, Inc.
   c. HIT-HY 200 Safe Set System, Hilti, Inc.
   d. AT-XP acrylic, Simpson Strong-Tie Company, Inc.
2. In grouted concrete masonry:
   a. HIT-HY 70, Hilti, Inc.
   b. SET epoxy, Simpson Strong-Tie Company, Inc.
   c. AT-XP acrylic, Simpson Strong-Tie Company, Inc.
3. In ungrouted concrete masonry:
   a. HIT-HY 70, Hilti, Inc.
   b. SET epoxy, Simpson Strong-Tie Company, Inc.
4. Adhesive anchor rods: As noted on the drawings.

2.03 PRIMER

A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer.

B. Galvanizing Repair Paint: ASTM A 780.

C. Cold Galvanizing Compound shall be "ZRC" cold galvanizing compound as manufactured by ZRC Worldwide, Marshfield, Massachusetts.

2.04 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, Grade B, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time, capable of developing a minimum compressive strength of 5,000 psi at 28 days.

2.05 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Comply with fabrication requirements, including tolerance limits, of AISC's "Code of Standard Practice for

Steel Buildings and Bridges", AISC's "Specification for Structural Steel Buildings", and as indicated on accepted shop drawings.

1. Camber structural-steel members where indicated.
2. Mill tolerances shall conform to ASTM A6. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.
3. Mark and match-mark materials for field assembly.
4. Plates shall be free of gross discontinuities such as ruptures and delaminations. Plates shall comply with ASTM A578, Level 1.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.

C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads. Members in compression joints which depend on contact bearing shall have the bearing surfaces milled to a common plane. Members to be milled shall be completely assembled before milling.

E. Base Plates: Oversize anchor bolt holes in base plates to facilitate erection as specified in Table 14-2 in AISC 360-10.

F. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning, SSPC-SP 2, "Hand Tool Cleaning, or SSPC-SP 3, "Power Tool Cleaning."

G. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

H. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.06 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM F3125, grade A 325 or grade A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

2. Provide washers over all slotted holes in an outer ply.

B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work. Welds not

specified shall be continuous fillet welds designed to develop the full strength of the member. A combination of welds and bolts shall not be used to transmit stress at the same face of any connections. Clean completed welds prior to inspection. Slag shall be removed from all completed welds.

2.07 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Surfaces to be high-strength bolted with slip-critical connections.
4. Galvanized surfaces.
5. Top surfaces of beams which support composite metal floor deck.
6. Headed shear studs, although overspray is acceptable.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.08 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/ A 123M.

1. Fill vent holes and grind smooth after galvanizing.

B. Galvanizing: The following steel shall be hot-dip galvanized (including any associated fasteners):

1. Lintels and shelf angles attached to structural-steel frame and located in exterior walls.
2. Railing exposed to weather.

2.09 SOURCE QUALITY CONTROL

A. Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM F3125, grade A 325 or grade A 490 Bolts."

D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1 and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
3. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1 for stud welding and as follows:

1. Bend tests will be performed if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.

PART 3 - EXECUTION

3.01 EXAMINATION

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

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

3.02 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Design of temporary bracing and supports shall be the responsibility of the Contractor. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

3.03 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design," unless closer tolerances are required for proper fitting of adjoining or enclosing materials, in which case the more stringent shall apply.

B. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.

1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of base plate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.

4. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
5. Grout under baseplates in accordance with Section 033000.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges," Unless adjoining materials dictate a tighter tolerance.

D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated. Any member having a splice not shown and detailed on the accepted shop drawings shall be rejected.

F. Do not field cut or alter structural members without approval of Architect/Engineer. Do not use thermal cutting during erection unless approved by Architect/Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1.

G. Gas Cutting: Do not use gas cutting torches in the field to correct fabrication errors in structural framing.

H. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

I. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

3.04 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM F3125, grade A 325 or grade A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

2. A307 bolts and high-strength (ASTM F3125, grade A325 and grade A490) bolts noted to be "snug-tight" shall be tightened using a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench, bringing the plies into contact.

3. High-strength bolts which are not specifically designated to be "snug-tight" shall be tightened to provide at least the minimum tension shown in Table 4 of the "Specification for Structural Joints using ASTM F3125, grade A325 and grade A490 Bolts." Tightening shall be done by the turn-of-the-nut method, with direct tension indicators, or by properly calibrated wrenches.

4. Bolts tightened with a calibrated wrench or by torque control shall have a hardened washer under the element (nut or bolt head) turned in tightening.

5. Hardened washers shall be placed over slotted holes in an outer ply. Hardened beveled washers shall be used where the outer face of the bolted parts has a slope greater than 1:20 with respect to the bolt axis.

B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work. Welds not specified shall be continuous fillet welds designed to develop the full strength of the member. A combination of welds and bolts shall not be used to transmit stress at the same face of any connections. Clean completed welds prior to inspection. Slag shall be removed from all completed welds.

1. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings" for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

B. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM F3125, grade A 325 or grade A 490 Bolts."

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1.

1. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following inspection procedures, at testing agency's option:

a. Liquid Penetrant Inspection: ASTM E 165.
b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
c. Ultrasonic Inspection: ASTM E 164.
d. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.

E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.06 REPAIRS AND PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Touch-up Cold Galvanizing: Touch up areas of hot dip galvanized members where galvanizing has been abraded during shipping and erection and areas where galvanizing has been removed or damaged due to welding. Apply cold galvanizing compound in accordance with the manufacturer's instructions to a minimum dry film thickness of 2.0 mils.

END OF SECTION 05 12 00

SECTION 053100 - STEEL DECK

PART 2 - GENERAL

2.01 RELATED DOCUMENTS

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

2.02 SUMMARY

A. This Section includes the following:

1. Roof deck.

B. Work Included

1. Furnish all labor and materials required to fabricate, deliver and install steel roof deck and accessories including formed steel cant strips, eave strips, valley strips, sump pans, edge closures, pour stops, reinforcing plates and related accessories.
2. Furnish all labor and materials required to fabricate, deliver and install steel floor deck and accessories including formed steel end closures, edge forms, flashings, and reinforcing plates, headed shear studs, and related accessories.

C. Related Sections include the following:
1. Division 3 Section "Cast-in-Place Concrete" for structural concrete fill over steel deck.
2. Division 5 Section "Structural Steel" for shop- and field-welded shear connectors.
3. Division 5 Section "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

2.03 SUBMITTALS

A. Submittals for Review:

1. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.
2. Product Data: For each type of deck, accessory, and product indicated. Provide deck dimensions, sectional properties, uplift resistance and diaphragm capacity for specified fastener layout and support spacing, and finishes.

B. Submittals for Information:

1. Product Certificates: For each type of steel deck, signed by product manufacturer. Certify that products comply with SDI, UL and ICC standards as specified.
2. Manufacturer’s installation instructions.
3. Welding certificates: For each welder employed on the Work.
4. Field quality-control test and inspection reports.
5. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

a. Power-actuated mechanical fasteners.

6. ICC Evaluation Service Reports: Deck units shall be approved by the International Code Council and shall have a corresponding report from ICC.
7. Deck units shall be classified by Underwriter's Laboratory, Inc. and shall be labeled and marked as required by UL, indicating manufacturer testing and inspection.

2.04 QUALITY ASSURANCE

A. Installer: Company specializing in performing the work of this Section with minimum 5 years documented experience.

B. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated.

C. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

D. Fire-Test-Response Characteristics: Where indicated, provide steel deck units identical to those tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: Indicated by design designations of applicable testing and inspecting agency.
2. Steel deck units shall be identified with appropriate markings of applicable testing and inspecting agency.

E. Comply with applicable provisions of the following specifications and documents.

1. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
2. FM Global Listing: Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.
3. SDI (Steel Deck Institute) - Design Manual for Composite Decks, Form Decks, Roof Decks.
4. UL - Fire Resistance Directory.

2.05 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 3 - PRODUCTS

3.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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

1. Steel Deck:
   a. Canam Steel Corp.;The Canam Manac Group.

b. Consolidated Systems, Inc.
c. Epic Metals Corporation.
d. New Millennium Building Systems, LLC.
e. Nucor Corp.; Vulcraft Division.
f. Verco Manufacturing Co.
g.

3.02 ROOF DECK

A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30, and with the following:

1. Galvanized Steel Sheet: ASTM A 653/A, Structural Steel (SS), Grade 33, G60 zinc coating.
2. Deck Profile: As indicated.
3. Profile Depth: As indicated.
4. Design Uncoated-Steel Thickness: As indicated.
5. Span Condition: As indicated.
6. Side Laps: Overlapped.

3.03 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

1. Mechanical Fasteners: Galvanized hardened steel, self-tapping "Teks" screws, manufactured by Illinois Tool Works, Inc., Buildex Division, or equal. Size shall be #10 minimum, unless noted otherwise.
2. Powder Actuated Fasteners: Zinc coated fastener with .145 inch shank diameter and 1 1/4 inch shank length. X-DNI pin as manufacturer by Hilti, or equal.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

E. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.

F. Galvanizing Repair Paint: ASTM A780.

PART 4 - EXECUTION

4.01 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

4.02 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, manufacturer's written instructions, and requirements in this Section.

B. Locate deck bundles to prevent overloading of supporting members.

C. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

D. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

E. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

F. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

G. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

H. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

4.03 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:

1. Weld Diameter: As indicated.
2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds as indicated.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges as indicated

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped 2 inches minimum.

D. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels, unless otherwise indicated.

E. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

F. Architectural finishes and mechanical, electrical, and plumbing equipment shall not be hung directly from the metal deck.

4.04 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

4.05 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 31 00

SECTION 05 40 00 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:
   1. Exterior non-load-bearing wall framing.

B. Related Sections include the following:
   1. Division 05 Section - Metal Fabrications.
   2. Division 06 Section - Rough Carpentry for subflooring, wall sheathing, or roof sheathing using wood-based structural-use panels, particleboard, fibrous-felted board, and foam-plastic sheathing.
   3. Division 07 Section - Thermal Insulation.
   4. Division 07, Air Barrier Section(s).
   5. Division 09 Section - Gypsum Board Assemblies for interior non-load-bearing metal-stud framing assemblies, and exterior gypsum sheathing.
   6. Division 09 Section - Metal Support Systems, for ceiling and soffit suspension assemblies.

1.03 DEFINITIONS

A. Minimum Uncoated Steel Thickness: Minimum uncoated thickness of cold-formed framing delivered to the Project site shall be not less than 95 percent of the thickness used in the cold-formed framing design. Lesser thicknesses shall be permitted at bends due to cold forming.

B. Producer: Entity that produces steel sheet coil fabricated into cold-formed members.

1.04 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Division 01, Section "Quality Requirements," to design cold-formed steel framing.

B. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.
   1. Where stud gauges are noted in Drawings, such gauges are minimum allowed gauges. Provide gauges per delegated design, or noted gauges, whichever is greater.
   2. Design Loads: As indicated and per local code requirements.
   3. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
      a. Exterior Non-Load-Bearing Curtain-Wall Framing:
         1) Metal panel finish: Horizontal deflection of 1/360 of the wall height.
         2) Masonry veneer or plaster/stucco finish: Horizontal deflection of 1/600 of the wall height.
   4. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.

5. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
    a. Upward and downward movement of 1/240 of the span.

C. Design exterior non-load-bearing curtain-wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of cold-formed metal framing product and accessory indicated.

B. Shop Drawings: Provide shop drawings prepared by cold-formed metal framing manufacturer or other delegated design engineer.
1. Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining Work.
3. For cold-formed metal framing indicated to comply with design loads, include structural analysis data and detailed shop drawings signed and sealed by the qualified professional engineer registered in the state responsible for their preparation, and where project is located.

1.06 INFORMATIONAL SUBMITTALS

A. Mill certificates signed by steel sheet producer or test reports from a qualified independent testing agency indicating steel sheet complies with requirements.

B. Welding Certificates: Copies of certificates for welding procedures and personnel.

C. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

D. Product Test Reports: From a qualified testing agency indicating that each of the following complies with requirements, based on comprehensive testing of current products:
1. Expansion anchors.
2. Power-actuated anchors.
3. Mechanical fasteners.
4. Vertical deflection clips.
5. Miscellaneous structural clips and accessories.

E. Research/Evaluation Reports: Evidence of cold-formed metal framing's compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
1. Third party evaluation report for products reviewed to local building code or its model code and AISI S100.

1.07 QUALITY ASSURANCE

A. Engineering Responsibility: Engage a qualified professional engineer to prepare design calculations, Shop Drawings, and other structural data.

B. 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 cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.

C. Installer Qualifications: An experienced installer who has completed cold-formed metal framing similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

D. Mill certificates signed by steel sheet producer or test reports from a qualified independent testing agency indicating steel sheet complies with requirements, including uncoated steel thickness, yield strength, tensile strength, total elongation, chemical requirements, and galvanized-coating thickness.

E. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

F. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

G. Fire-Test-Response Characteristics: Where metal framing is part of a fire-resistance-rated assembly, provide framing identical to that of assemblies tested for fire resistance per ASTM E 119, and displaying a classification label from, a testing and inspecting agency acceptable to authorities having jurisdiction.
   1. Fire-Resistance Ratings: Indicated by GA File Numbers in GA-600, "Fire Resistance Design Manual," or by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.

H. AISI Specifications: Comply with AISI's "Specification for the Design of Cold-Formed Steel Structural Members" or "Load and Resistance Factor Design Specification for Cold-Formed Steel Structural Members" and the following for calculating structural characteristics of cold-formed metal framing.
   1. CCFSS Technical Bulletin: "AISI Specification Provisions for Screw Connections."

I. Coordinate with insulation installer, if other than cold formed metal framing installer, to pack stud packs headers and similar construction that will not be accessible after erection, with batt insulation. Should Contractor fail to coordinate installation of batt thermal insulation, Contractor shall be responsible to foam insulate all such cavities at no additional cost to Owner, prior to applying interior sheathing.

J. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section - Project Management and Coordination.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling, and as required in AISI/s "Code of Standard Practice".

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation, and as required in AISI/s "Code of Standard Practice".

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:
   1. Allied Building Products, Inc.
   2. AllSteel Products, Inc.
   3. Cemco.
   4. Clark-Dietrich Building Systems.
   5. Consolidated Fabricators Corp.

6. MarinoWare; Div. of Ware Industries, Inc.
7. MBA Building Supplies.
8. Scafco Corp.
9. United Metal Products, Inc.

2.02 MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25]** percent.

B. Steel Sheet: ASTM A 1003/A 1003M, structural steel, zinc coated, of grade and coating as follows:
   1. Grade: As required by structural performance.
   2. Coating: G60 Galvanized finish.

C. Steel Sheet for Vertical Deflection and Drift Clips: ASTM A 1003/A 1003M, A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
   1. Grade: As required by structural performance.
   2. Coating: G90.

2.03 NONLOAD-BEARING EXTERIOR WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, complying with ASTM C 955, and as follows:
   1. Minimum uncoated steel thickness: .0538 inch (16 ga.)
   2. Flange width: 1-5/8 inches.
   3. Provide greater than minimum dimensions where indicated in the Drawings, and where required by Engineer’s cold formed metal framing design as indicated in shop drawings.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, complying with ASTM C 955 of manufacturers standard flange width and minimum thickness matching steel stud.
   1. Where curved applications are indicated in Drawings, provide custom pre-curved tracks, or segmented track capable of producing a smooth arc to indicated radiuses.

C. Slotted Deflection Track: Manufacturer’s single, deep-leg, U-shaped steel track; punched with vertical slots in both legs. Studs should be positively attached to deep-leg track using vertical slots while allowing free vertical movement. Legs designed to support horizontal and lateral loads and transfer them to the primary structure.

D. Z-Shaped Furring Channels: With slotted or non-slotted web, face flange of 1-1/4", and wall attachment flange of 7/8". Minimum 20 gauge galvanized steel, or heavier where required by weight of and deflection limits for attached finish systems. Sizes: as indicated in Drawings.

E. Z-Shaped Furring: With non-slotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, and depth required to fit insulation thickness indicated.
   1. Nominal Thickness: 0.025 inch.

F. Vertical Deflection Clips: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure, without imposing vertical load on the wall framing.

2.04 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories of the same material and finish used for framing members, with a minimum yield strength of 33,000 psi.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
   1. Supplementary framing.

2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. End clips.
5. Foundation clips.
6. Gusset plates.
7. Stud kickers, knee braces, and girts.
8. Joist hangers and end closures.
9. Hole reinforcing plates.
10. Backer plates.

2.05 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123.

B. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

C. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

D. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-threading steel drill screws.
   1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

E. Welding Electrodes: Comply with AWS standards.

2.06 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A 780.

B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.

D. Shims: Load bearing, high-density multimonomer plastic, nonleaching.

E. Sealer Gaskets: 5-12" x 3/8" closed cell foam and adhesive backed peel and stick membrane, equal to Protecto Wrap (800-759-9727) "Triple Guard Energy Sill Sealer." Provide at all exterior metal studs in contact with floor slab.

2.07 SHEATHING

A. Sheathing: Comply with requirements in Division 09 Section - Gypsum Board Assemblies.

2.08 FABRICATION

A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to manufacturer's written recommendations and requirements in this Section.
   1. Fabricate framing assemblies using jigs or templates.
   2. Cut framing members by sawing or shearing; do not torch cut.

3. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.
    a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.
4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Grout bearing surfaces uniform and level to ensure full contact of bearing flanges or track webs on supporting concrete or masonry construction.

B. Install sealer gaskets per manufacturer's instructions to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at exterior wall stud locations, with self adhesive legs of T-shaped membrane adhered to face of sheathing and to vertical face of concrete slab or foundation.

3.03 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing according to ASTM C 1007 and AISI S200 "North American Standard for Cold-Formed Steel Framing - General Provisions", unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
1. Bolt or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to manufacturer's written recommendations and requirements in this Section.
1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.

E. Install framing members in one-piece lengths, unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

H. Install insulation in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

J. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.04 EXTERIOR NON-LOAD-BEARING WALL FRAMING INSTALLATION

A. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable exterior wall-framing system.

B. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

C. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:
1. Stud Spacing: As indicated or required by design.

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

E. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
1. Install single deep-leg deflection tracks and anchor to building structure.
2. Connect vertical deflection clips to bypassing studs and anchor to primary building structure.

F. Install horizontal bridging in exterior wall studs, spaced in rows indicated on Shop Drawings but not more than 54 inches apart. Fasten at each stud intersection.
1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.

G. Install Z-shaped furring in exterior insulation plane where indicated and as required to support exterior finish materials. Install C or J shaped furring around perimeter of building openings as required to support edges of finish materials, and where required to provide for attachment of windows, and at other locations as indicated in Drawings.

3.05 EXTERIOR FURRING INSTALLATION

A. Installation of furring at continuous insulation
   1. Erect furring vertically to hold insulation specified in Division 07, Section "Thermal Insulation" in place. Z-shaped furring members spaced to match stud spacing
   2. Erect furring horizontally to hold insulation specified in Division 07, Section "Thermal Insulation" in place. Z-shaped furring members spaced 24 inches maximum o.c.
   3. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
   4. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.
   5. At window and door openings, provide C or J shaped perimeter furring or tracks where detailed in Drawings.
   6. At jambs and heads of openings in fire rated cavity walls, install 16 gauge C or J shaped perimeter framing or tracks of solid profile without cut-outs, where detailed in Drawings and where required for flame spread prevention into cavity. Framing sized to fill space from face of sheathing to back side of loose lintel, masonry veneer, or other non-combustible finish material.

B. Furring Channels for metal panels: Refer to Division 07 Section "Metal Wall Panels".

3.06 SHEATHING INSTALLATION

A. General: Install sheathing to comply with Division 09 Section - Gypsum Board.
   1. Coordinate framing installation with sheathing, flashing, waterproofing or air barrier, and sealants installation.

B. Air-Infiltration Barrier Application:
   1. Refer to Division 07 Section - Fluid Applied Air Barrier.

3.07 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing agency to perform field quality-control testing.

B. Field and shop welds will be subject to inspection and testing.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace Work that does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

3.08 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Touchup Painting: Wire brush, clean, and paint scarred areas, welds, and rust spots on fabricated and installed prime-painted, cold-formed metal framing. Paint framing surfaces with same type of shop paint used on adjacent surfaces.

C. Protect paper-surfaced gypsum sheathing that will be exposed to weather for more than 30 days by covering exposed exterior surface of sheathing with a securely fastened air-infiltration barrier. Apply covering immediately after sheathing is installed.

D. Protect cutouts, corners, and joints in sheathing by filling with a flexible sealant or by applying tape recommended by sheathing manufacturer at time sheathing is applied.

E. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 40 00

SECTION 05 50 00 - METAL FABRICATIONS

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. General: Furnish all labor, supervision, materials, tools, equipment, appliances and services necessary for the fabrication, delivery and installation of all miscellaneous metal items. All work shall be as shown or indicated on the drawings and as specified in this section.

B. Scope of Work:
   1. Embedded angles and plates
   2. Guardrails, Handrails, and Handrail Brackets
   3. Stair Nosings
   4. Ladders and safety cages
   5. Steel Equipment Supports
   6. Pipe Bollards
   7. Vehicular Sign Posts
   8. Miscellaneous metal work and related items.
   9. Shop Priming and Finishing of Metal Fabrications

C. Related Sections include the following:
   1. Division 03 Section - Concrete.
   2. Division 04 Section - Unit Masonry.
   3. Division 05 Section - Metal Pan Stairs.
   4. Division 05 Section - Aluminum Ships Ladder.
   5. Division 06 Section - Rough Carpentry, for concealed blocking for attachment of metal fabrications.
   6. Division 07 Section - Roof Accessories, for roof hatches and ladder safety devices attached to fabricated ladders.
   7. Division 08 Section - Access Doors and Panels, for metal floor hatches.
   8. Division 09 Section - Painting.
   9. Division 09 Section - Special Coatings.
   10. Division 11 and other Sections for equipment requiring miscellaneous steel support structure.

1.03 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design ladders, miscellaneous supports, and railings, including engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design Criteria:
   1. Ladders and stairs designed to withstand live loading conditions of 100 lb. per square feet.
   2. Handrails, Guardrails, or other protective enclosures shall be designed to withstand stresses to which they would be normally subjected, and to support a load of 50 lb per linear foot applied perpendicular at the top of the rail or guard, and to withstand a load of 200 lbs. applied in any direction at any point on the top of the rail or guard without deflection.

3. Connections other than those already listed shall be designed to safely support design load (dead load plus live load) of not less than 100 psi without exceeding working stresses permitted for materials.
4. Design ladders to include platforms and safety cages where shown in Drawings and where required by local code and authorities having jurisdiction.
5. Miscellaneous equipment supports per local code requirements, equipment Manufacturers' requirements and as specified herein.

1.04 QUALITY ASSURANCE

A. Steel stairs in accordance with latest NAAMM Standards and AISC.

B. Welding shall conform to American Welding Society's Standard Code for Arc and Gas Welding in Building Construction. Welding shall be continuous along entire area of contact, except where tack welding is specifically shown or specified. Grind all exposed welds.

1.05 SUBMITTALS

A. LEED Submittals:
1. Product Data for Credit MR4.2: For products having recycled content, documentation indicating percentages by weight of pre-consumer and postconsumer recycled content. Include statement including cost for each product having recycled content.
2. Laboratory Test Reports for Credit IEQ 4: For primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers".

B. Shop drawings based on the Contract Documents shall be submitted to the Architect for review prior to ordering of materials.

C. Failure by the contractor to submit shop drawings, test reports, etc. required above shall release the Architect and the Engineer from any liabilities due to the negligence on the part of the contractor to comply with the construction documents.

D. Approval will cover size and arrangement of members, character of construction, but not dimensions.

E. Contractor shall verify actual dimensions at the construction site.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Comply with the following standards, as pertinent:
1. Steel plates, shapes, and bars: ASTM A36;
2. Steel plates to be bent or cold-formed: ASTM A283; grade C;
3. Steel tubing (hot-formed, welded, or seamless): ASTM A500; grade B;
4. Steel bars and bar-size shapes: ASTM A306; grade 65, or ASTM A36;
5. Cold-finished steel bars: ASTM A108l
6. Cold-rolled carbon steel sheets: ASTM A336;
7. Galvanized carbon steel sheets: ASTM A526, with G90 zinc coating in accordance with ASTM A525;
8. Stainless steel sheets: AISI type 302 or 304, 24 ga. with number 4 finish;
9. Gray iron castings: ASTM A48, class 10;
10. Malleable iron castings: ASTM A47;
11. Steel pipe: ASTM A53, grade A, schedule 40, black finish unless otherwise noted;
12. Concrete inserts:

a. Threaded or wedge-type galvanized ferrous castings of malleable iron complying with ASTM A27.
b. Provide required bolts, shims, and washers, hot-dip galvanized in accordance with ASTM A153.

13. Bolts and nuts: Provide hexagon-head regular type complying with ASTM A307, grade A.
14. Lag bolts: Provide square-head type complying with Fed Spec FF-B-561;
15. Machine screws: Provide cadmium plated steel type complying with Fed Spec FF-S-111.

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

C. Castings shall be made from the best grade of soft pig iron cast in stove place molding sand to a uniform thickness. Castings shall be free of defects impairing strength or appearance.

D. Accessories: Provide all anchors bolts, anchor straps, hangers and other related fittings, fastener and accessories required for proper and secure installation of all miscellaneous metal. Fasteners for exterior use shall be zinc coated. Generally, the sizes, shapes and spacing of items are shown or specified; where not shown or specified, accessories shall be adequate for the required services, subject to approval.

2.02 ITEMS TO BE PROVIDED

A. Lintel Angles and Bent Plates: Galvanized steel in sizes indicated on Drawings. Extend loose lintel angles 8" on each side of opening.

B. Steel Pipe Guardrails: 1-1/4" Standard galvanized steel pipe with 1/2" x 1/2" bar verticals welded to pipe frame as detailed in Drawings. Hot-dipped galvanized steel at all exterior railings.

C. Steel Pipe Hand Railings: 1-1/4" Standard steel pipe fabricated with welded and round smooth connections as illustrated on Drawings or as required. Hot-dipped, galvanized steel pipe at all exterior handrailings, galvanize railings after fabrication. All railings to have closed ends.
1. Where railings do not return to post or to a vertical or horizontal surface, provide domed ends.
2. Except where specifically detailed otherwise, railings in new concrete shall be mounted to cast-in galvanized steel sleeves. Sleeves shall be 6” long or greater with an inside diameter not less than ½” greater than the outside diameter of post, with steel plate closure welded to bottom of sleeve.
3. Handrail Brackets: 1-1/2” wide x 1/4” thick steel bent plate handrail brackets, galvanized at exterior application.
4. Provide any other attachments to new and existing construction as required to comply with design loading criteria.

D. Illuminated Hand Rail: 1-1/2” stainless steel handrail with integral LED illumination. Basis of design: IRAIL – Viva Railings
1. Color: 3000K Warm White
2. Output: 250 lumens/ft.
3. Beam Angle: 120 Degrees
4. Power: 120V
5. Frosted Lens
6. # 6 satin rail finish

E. Stainless Steel Handrail: 1-1/2” Stainless Steel Handrail. Basis of Design: FSR – Viva Railings
1. #6 satin rail and post finish.

2. Post spacing 4’-0” o.c. max
3. Non-illuminated stainless steel handrail to match illuminated handrail in profile and finish.

F. Stair Nosings: 4” deep x 5/16” thick, cast metal safety tread nosings with cast-in aluminum oxide grit surface and concealed integral anchors on 10” centers for casting into concrete. Provide with protective tape to be removed at substantial completion.
1. Exterior Cast Concrete Stairs: Full width minus 3” on each side of stairs, anti-corrosive metal equal to Alumagrit 101, cross-hatched surface, as manufactured by Wooster Products, or approved equal.

G. Steel Ladder: Fabricate roof access ladders to configurations as indicated on drawings and as follows:
1. 3-3/8" x 1/2" plate stringers with 3/4" diameter solid steel rod rungs shouldered and welded to stringers.
2. Rungs spaced not over 12" apart. Distance from centerline of rungs to walls or obstructions not less than 6".
3. Stringers secured to wall by 1/4" x 3" x 7" bent steel plate brackets bolted to wall with 3/8" diameter toggle bolts. Brackets secured to wall at 24" O.C. turned inward.
4. Exterior ladders shall be galvanized.

H. Steel Safety Cage at Ladder: 2" x 3/8" Verticals at 6" o.c., welded to 5" x 3/8" hoops at 4'-0" o.c., horizontally.

I. Miscellaneous Equipment Supports: Field verify all dimensions and provide miscellaneous steel support structure for wall and ceiling mounted equipment as follows:
1. Where not specifically detailed, design and provide supports as required for all other equipment to be provided or installed under this contract.
2. All supports shall comply with requirements of the equipment Manufacturer(s) for support structure and shall provide adequate strength and secure attachment to building structure, braced against lateral movement.

J. Sidewalk Culvert: 3/8" galvanized checkerplate sidewalk culvert cover with countersunk screws.

K. Sidewalk Trench Cover & Frame: Standard support frame and bolted down solid checkered top of Gray Iron, Class 35 shall be Neenah Foundry Co., "Light Duty" Series #R-4991 with Type D skid resistant top, or approved equal by Barry Pattern & Foundry, Campbell, or McKinley Iron Works, in sizes as shown on drawings.

L. Pipe Bollards: 6" Diameter galvanized schedule 40 steel pipe with concrete fill. Mound concrete at top of bollard to shed water.
1. Size: 7'-0" in length, recessed 3'-0" below-grade. 4'-0" height above grade, unless otherwise indicated in Drawings.
2. Paint: Refer to Division 09, Section "Painting". Colors: safety yellow, or as selected by Architect.

M. Stainless Steel Removeable Pipe Bollard
1. Size: 4’-0” Height above grade. Manufacturer recommended embedment sleeve. 6” min. Diameter. Schedule 40 wall thickness.
2. Internally locking.
3. Type 316 Stainless, #4 Finish

N. Miscellaneous Steel Shapes: Channels, angles, plates, tubing, connections and bolts provided where shown and detailed on drawings. Exterior imbed plates, support angles, and other miscellaneous exterior steel shall be hot-dip galvanized.

2.03 SHOP PAINTING

A. All Iron and Steel Work: Unless otherwise specified, power tool clean all surfaces to remove mill scale. Work shall receive a shop coat of paint before leaving the factory or being exposed to the weather. Aluminum work contacting dissimilar metals shall receive a protective coating preventing galvanic action.

B. Shop Paint: Shop paint shall be Fabricator's standard, fast curing, lead free, "universal" primer, compatible with finish paint system indicated and for capability to provide sound foundation for field applied topcoats.

C. Aluminum surfaces to be in direct contact with concrete and masonry shall be shop coated with zinc chromate primer.

PART 3 - EXECUTION

3.01 FABRICATION

A. Contractor shall secure and be responsible for all field measurements required for the proper and accurate fabrication and installation of the items included under this section; field alterations will not be permitted except upon specific authorization of the Architect.

B. All work shall be assembled in the most substantial manner and reinforced where necessary with structural shapes, using concealed screws, bolts or similar fastenings. Make welds of adequate strength and durability, jointing tight, clean and smooth, flush and in true plane with base metals.

C. All screws or rivets shall be countersunk, unless otherwise noted. Provide lock washers for all bolts.

D. All steel to which wood blocking is connected shall be properly punched for anchoring blocking.

E. Exposed steel shapes with marred surfaces shall be ground or draw-filled to a fine grain finish, as approved before applying shop coat of paint.

F. Assembled work shall be completely constructed in the shop, accurately finished and the pieces match-marked for erection. Form exterior joints to exclude water, grind connections in exposed pieces smooth and polish.

G. The Contractor shall do all drilling, cutting, tapping and fitting of work to accommodate other work coming in contact with it, and shall furnish all taps, bolts and other fittings in connection therewith.

H. Except where otherwise noted, fastening to concrete, solid masonry or hollow masonry shall be with expansion bolts or anchors. Fastening to wood plugs will not be permitted. Toggle bolts may be used only when approved by the Architect.

3.02 INSTALLATION, GENERAL

A. All work included in this Contract shall be installed by the Contractor at the proper time and as rapidly as the progress of the adjacent and connecting work will permit.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true to line, and free of rack; and measured from established lines and levels.

C. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size

limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Field Welding:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
   5. Touch-up shop prime coats.

F. Immediately after erection, clean the field welds, bolted connections, and abraded areas of shop priming. Paint the exposed areas with same material used for shop priming.

G. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
   1. Cast Aluminum: Heavy coat of bituminous paint.
   2. Extruded Aluminum: Two coats of clear lacquer.

3.03 INSTALLATION, SPECIFIC ITEMS

A. Miscellaneous Framing and Supports:
   1. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
   2. Anchor supports securely to and rigidly brace from building structure.

B. Nosings and Treads:
   1. Center nosings on tread widths unless otherwise indicated.
   2. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.
   3. Unless otherwise indicated, install nosings as wide as possible, equal length on each step, and with ends of nosings installed in line at each stair.

C. Metal Pipe Bollards:
   1. Anchor bollards in concrete. Fill annular space around bollard solidly with nonshrink, nonmetallic grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard for positive drainage away from bollard base.
   2. Fill bollards solidly with concrete, mounding top surface to shed water.
   3. Paint bollards color(s) as approved by architect.

3.04 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 05 50 00

SECTION 05 58 13 - ARCHITECTURAL METAL COLUMN COVERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes snap-together metal column covers.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's product data, specifications and installation instructions.

B. Shop Drawings: Submit complete shop drawings indicating quantities, finishes, dimensions, and attachment relationships.

C. Samples for Initial Selection: Submit manufacturer's color charts showing the full range of colors, textures, and patterns

D. Samples for Verification: For each type of exposed finish required, prepared on 6-inch-square Samples of metal of same thickness and material indicated for the Work.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Mill Certificates: Signed by stainless-steel manufacturers certifying that products furnished comply with requirements.

1.05 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finish to include in maintenance manuals.

1.06 QUALITY ASSURANCE

A. Manufacturer shall have a minimum of 5 years' experience in manufacturing and shall have successfully completed at least twenty projects within the past five years in architectural metals.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
   1. Build mockups of typical column covers.
   2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver column covers wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.

B. Storage components in locations that will avoid damage from job-site traffic, moisture, stacking or other job-site contamination.

C. Handle components to avoid racking, twisting, denting or scratching of finished surfaces.

1.08 WARRANTY

A. Provide manufacturer's warranty against defects in material and workmanship for a period of one year beginning on Date of Substantial Completion.

B. Fluoropolymer finish warranty: Warrant fluoropolymer coating to remain free, under normal atmospheric conditions, from peeling, checking, cracking, chalking in excess of numberal rating of 8 when measured in accord with ASTM D2414, of fading in excess of 5 N.B.S. Units during warranty period. Warranty period shall be 10 years, beginning at Date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Product: The design for the architectural metal column cover system is based on products as manufactured by FRY REGLET CORPORATION; 1377 Stonefield Court Alpharetta, GA 30004; Phone 800-955-2343; FAX 800-200-4379. Subject to compliance with requirements, provide the named product, or approved equal product by another manufacturer.
   1. Architect reserves the right to reject equal manufacturers based on, in Architect's sole opinion, relative aesthetic value of the panel system.

2.02 PRODUCTS

1. Series R - Reveal Vertical Joint
   a. Stainless steel: Type 304 stainless steel, complying with ASTM A789.
      1) Thickness: 16 gage.
      2) Finish: Brushed #4.
   b. Vertical Joint Type: Flush
   c. Horizontal Joint Type:
      1) Ceiling Joint: Flush
      2) Intermediate Joint: Flush
      3) Floor Joint: Flush

2.03 MISCELLANEOUS MATERIALS

A. Fasteners: Fabricated from same basic metal and alloy as fastened metal unless otherwise indicated. Do not use metals that are incompatible with materials joined.
   1. Provide concealed fasteners for interconnecting column covers and for attaching them to other work unless otherwise indicated.

B. Sound-Deadening Materials:
   1. Insulation: Unfaced, mineral-fiber blanket insulation complying with ASTM C665, Type I, and passing ASTM E136 test.
   2. Mastic: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

C. Backing Materials: Provided or recommended by column cover manufacturer.

2.04 FABRICATION

A. Coordinate dimensions and attachment methods of column covers with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.

B. Form column covers to specified dimensions and diameters as indicated on shop drawings. Produce flat, flush surfaces without cracking or grain separation at bends.

C. Provide column covers in sections a maximum 12' 0" tall per section. Provide additional sections to achieve finished heights above 12' 0".

D. Columns shall have no exposed fasteners unless specified.

E. Provide additional bracing components as necessary to stiffen substructure and insure solid mid- span bracings and connections. (By others)

2.05 GENERAL FINISH REQUIREMENTS

A. Complete mechanical finishes of flat sheet metal surfaces before fabrication where possible. After fabrication, finish all joints, bends, abrasions, and other surface blemishes to match sheet finish.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.

D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.06 STAINLESS STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of column covers.

B. Verify dimensions of column covers prior to installation to assure compatibility with job-site conditions.

C. Verify post structure is plumb, level, and parallel prior to installation of column covers.

D. Visually examine finished surfaces to assure that blemished or dented surfaces are not present prior to installation.

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

3.02 INSTALLATION

A. Locate and place column covers plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install column covers.

1. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

B. Install components in accord with manufacturer’s installation instructions and approved shop drawings.

C. Anchor components to related structures such as floors, walls and beams as indicated on approved shop drawings. Use anchors with holding strength to provide a solid installation. Use only plated, galvanized or stainless steel anchors.

D. Use concealed anchorages where possible.

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

F. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.

3.03 ADJUSTING AND CLEANING

A. Remove protective coverings and clean column covers to remove adhesives and tape residue. Test all solvents on non-exposed surfaces prior to use.
   1. For painted surfaces, use a mild detergent solution on a soft cloth.
   2. For stainless steel, use a glass cleaner and a soft cloth.
   3. For other surfaces, contact manufacturer for proper cleaning procedures

B. Visually inspect all exposed surfaces for scratches or blemishes.

C. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

3.04 PROTECTION

A. Protect finishes from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

END OF SECTION 05 70 00

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Rooftop support curbs.
   2. Wood blocking, cants and nailers.
   3. Wood furring and grounds.
   4. Wood sleepers.
   5. Plywood.

B. Related Requirements:
   1. Division 3 Section “Concrete Formwork.”
   2. Division 5 Section “Miscellaneous Metals.”
   3. Division 6 “Architectural Woodwork.”
   4. Division 8 “Hollow Metal Doors and Frames.”
   5. Division 8 “Wood Doors.”
   6. Division 8 “Finish Hardware.
   7. Division 9 “Paint.”

1.03 DEFINITIONS

A. Exposed Framing: Framing not concealed by other construction.

B. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.

C. Timber: Lumber of 5 inches nominal or greater in least dimension.

D. Lumber grading agencies, and the abbreviations used to reference them, include the following:
   1. NeLMA: Northeastern Lumber Manufacturers' Association.
   2. NLGA: National Lumber Grades Authority.
   3. RIS: Redwood Inspection Service.
   4. SPIB: The Southern Pine Inspection Bureau.
   5. WCLIB: West Coast Lumber Inspection Bureau.
   6. WWPA: Western Wood Products Association.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
   1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
   2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.

3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. Fastener Patterns: Full-size templates for fasteners in exposed framing.

1.05 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

B. Evaluation Reports: For the following, from ICC-ES:
1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Power-driven fasteners.
4. Powder-actuated fasteners.
5. Expansion anchors.
6. Metal framing anchors.

1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.01 WOOD PRODUCTS, GENERAL

A. Certified Wood: Materials shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
1. Dimension lumber framing.
2. Timber.
3. Laminated-veneer lumber.
4. Parallel-strand lumber.
5. Miscellaneous lumber.

B. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piec

3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
4. Provide dressed lumber, S4S, unless otherwise indicated.

C. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness unless otherwise indicated.

D. Engineered Wood Products: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
1. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

E. Lumber fabricated from old growth timber is not permitted.

2.02 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.

D. Application: Treat all rough carpentry unless otherwise indicated and the following:
1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.03 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of

significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Use treatment that does not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
4. Design Value Adjustment Factors: Treated lumber shall be tested according ASTM D 5664 and design value adjustment factors shall be calculated according to ASTM D 6841. For enclosed roof framing, framing in attic spaces, and where high temperature fire-retardant treatment is indicated, provide material with adjustment factors of not less than 0.85 modulus of elasticity and 0.75 for extreme fiber in bending for Project's climatological zone.

C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
   1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by testing agency.

E. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.

F. Application: Treat all rough carpentry unless otherwise indicated, and the following:
   1. Framing for raised platforms.
   2. Framing for stages.
   3. Concealed blocking.
   4. Framing for non-load-bearing partitions.
   5. Framing for non-load-bearing exterior walls.
   6. Roof construction.
   7. Plywood backing panels.

2.04 DIMENSION LUMBER FRAMING

A. Non-Load-Bearing Interior Partitions:
   1. Application: Interior partitions not indicated as load-bearing.
   2. Species:
      a. Hem-fir (north); NLGA.
      b. Mixed southern pine; SPIB.
      c. Spruce-pine-fir; NLGA.
      d. Hem-fir; WCLIB, or WWPA.
      e. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
      f. Northern species; NLGA.
      g. Eastern softwoods; NeLMA.
      h. Western woods; WCLIB or WWPA.

2.05 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
   1. Blocking.
   2. Nailers.
   3. Rooftop equipment bases and support curbs.
   4. Cants.
   5. Furring.
   6. Grounds.
   7. Utility shelving.

B. For items of dimension lumber size, provide Construction or No. 2 and the following species:
   1. Hem-fir (north); NLGA.
   2. Mixed southern pine; SPIB.
   3. Spruce-pine-fir; NLGA.
   4. Hem-fir; WCLIB or WWPA.
   5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
   6. Western woods; WCLIB or WWPA.
   7. Eastern softwoods; NeLMA.

C. For utility shelving, provide lumber with 19 percent maximum moisture content and any of the following species and grades:
   1. Eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine.
   2. Mixed southern pine; No. 1 grade; SPIB.
   3. Spruce-pine-fir (south) or spruce-pine-fir.

D. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:
   1. Mixed southern pine; No. 2 grade; SPIB.
   2. Spruce-pine-fir (south) or spruce-pine-fir.
   3. Western woods; Construction or No. 2 Common.

E. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

F. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

G. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.06 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: DOC PS 1, Exterior, AC, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.
   1. Plywood shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.07 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
   1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Lag Bolts: ASME B18.2.1.

F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
   1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
   2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

2.08 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets: 5-1/2" x 3/8" closed cell foam and adhesive backed peel and stick membrane, equal to Protecto Wrap (800-759-9727) "Triple Guard Energy Sill Sealer."

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

C. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.

E. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.

F. Fastenings for Wall Supported Items: Provide and install 2 x 8 (minimum) x 1 stud space wood blocking, unless specified otherwise at all stud wall areas receiving grab bars, toilet partitions, wall bumpers and other wall mounted accessories.

G. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
   1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

H. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
   1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
   2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not

inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal- thickness.

3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.

I. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

J. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.

K. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

L. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.
1. Comply with fastener patterns where applicable.
2. Use finishing nails unless otherwise indicated. Countersink nail heads and fill holes with wood filler.
3. Use common nails unless otherwise indicated. Drive nails snug but do not countersink nail heads.

3.02 WOOD GROUND, SLEEPER, BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

D. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.03 WOOD FURRING INSTALLATION

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal- size furring horizontally and vertically at 24 inches o.c.

C. Furring to Receive Gypsum Board, Plaster Lath: Install 1-by-2-inch nominal- size furring vertically at 16 inches o.c.

3.04 ROUGH HARDWARE

A. Provide bolts, screws, anchors, inserts and fastenings required for proper attachment of carpentry and millwork items. Fastenings to concrete or masonry with expansion bolts or anchors. Toggle bolts may be used for hollow masonry. Fastening to wood plugs not permitted. Fastenings spaced 16" o.c. unless otherwise noted.

3.05 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 10 00

SECTION 06 20 13 - EXTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Work includes all labor, materials, equipment and services necessary for fabrication and installation of pre-finished composite wood veneer panel exterior wall cladding as shown on drawings and as herein specified.

B. Related Requirements:
   1. Division 05 Section - Cold Formed Metal Framing, for sub-girts and support framing.
   2. Division 06, Section "Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view and for framing exposed to view.
   3. Division 07 Section - "Sheet Metal Flashing and Trim", for coordination of air barrier and terminations between metal wall panels, and roofing and parapet copings.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.
   1. Include preparation instructions and recommendations
   2. Storage and handling requirements and recommendations.
   3. Include installation methods.

B. Shop Drawings: Showing dimensions, profiles, cladding system, attachments to adjacent construction, components, and other pertinent details for each product indicated.

C. Samples for Initial Selection: For each type of product involving selection of colors, profiles, or textures.

1.04 INFORMATIONAL SUBMITTALS

A. Evaluation Reports from ICC-ES.

B. Installer Qualifications: Certification that installer is experienced in the installation of the specified products, and has completed installations similar in extent and design.

C. Sample Warranty: For manufacturer's warranty.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in manufacturer’s original, unopened packaging, with labels clearly identifying product name and manufacturer.

B. Panel Storage: Place inspected panels in a climate controlled enclosed space. Horizontal storage: Lay panels on an elevated flast surface with max 24” between supports to ensure even distribution of loads. Storage time cannot exceed five months as of factory dispatch date. Protective peel-off sheet must be removed immediately after panel is installed.

C. Protect materials during handling to prevent damage.

D. Handling: Open crate within 72 hours of material delivery. Remove extra top panel and inspect contents by lifting each panel vertically to prevent chafing of the decorative face. Protect materials during handling to prevent damage.

E. Re-package per the original packaging until material is ready to install.

1.06 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecast weather conditions permit work to be performed and at least one coat of specified finish can be applied without exposure to rain, snow, or dampness.

B. Coordinate composite wood veneer panel installation with rain drainage work, flashing, trim, construction of canopies and soffit supports, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

C. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.
   1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

1.07 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace failed materials or workmanship within specified warranty period. Inspect items upon receipt for damage during shipping; concealed damage must be reported within 72 hours of delivery.
   1. Warranty Period for Composite Wood Veneer Panel: Ten year limited warranty

PART 2 - PRODUCTS

2.01 MANUFACTURERS

1. Basis of Design Products: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to the following:
   a. Prodema

2.02 MATERIALS

A. Exterior wood veneer wall and soffit panel:
   1. Basis of Design Product: PRODEMA-PRODEX
      a. Panel: 14mm.Grade A Rotary cut hardwood veneer bonded to a bakelite core.
      b. Support system: Concealed fastening with hanging hooks.
         1) Provide all components for a complete assembly.
      c. Fire Rating: Class A in accordance with ASTM E-84 criteria for flame spread 10 and smoke development 110 and class 1 (M1) fire rating in accordance with UNE-EN 2372.
         1) NFPA 285 Multi-Story Fire Test
         2) NFPA 268 Self-Ignition Test
      d. Panel Dimensions: 4” x 96”

B. Interior Wall and Ceiling Cladding
   1. Basis of Design Product: PRODEMA-PROLINGA
      a. Panel: 14mm.Grade A Rotary cut hardwood veneer bonded to a bakelite core.
      b. Support system: Concealed fastening with hanging hooks.
         1) Provide all components for a complete assembly.

c. Fire Rating: Class A in accordance with ASTM E-84 criteria for flame spread 10 and smoke development 110 and class 1 (M1) fire rating in accordance with UNE-EN 2372.
d. Panel Dimensions: 4” x 96”

2.03 MISCELLANEOUS MATERIALS

A. Fasteners for Exterior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.
   1. For prefinished items, provide matching finish fasteners where face fastening is required.

B. Flashing: Comply with requirements in Division 07, Section "Sheet Metal Flashing and Trim" for flashing materials installed in exterior finish carpentry.

C. Sealants:
   1. For manufactured items: As recommended by Manufacturer for conditions indicated.
   2. For Wood: Latex, complying with ASTM C 834 Grade NF and applicable requirements in Division 07, Section "Joint Sealants" and recommended by sealant and substrate manufacturers for intended application.

D. Panel Dimensions: As indicated on the drawings

E. Trim: As indicated on the drawings

2.04 FABRICATION

A. Back out or kerf backs of standing and running trim wider than 5 inches, except members with ends exposed in finished work.

PART 3 - EXECUTION

3.01 COORDINATION AND INSPECTION

A. Coordinate with other trades, prior to rough-in and penetrations, exact locations for roughing-in of components and systems penetrating composite wood veneer panels to verify actual locations of penetrations relative to seam locations of composite wood veneer panels. Conduit, pipe and other small penetrations shall not be located in panel seams. Examine and confirm these locations again before installation to avoid conflicts.
   1. Contractor is responsible to relocate pipe and similar penetrations as required to avoid seams. Contractor shall not be due additional compensation to relocate items and make other corrections as required due to failure of Contractor to coordinate between trades.

B. Fabricator and erector are responsible for inspecting existing conditions to verify general conditions, panel profiles and panel attachments and examine all parts of existing building affecting the installation of his work.
   1. Examine sheathing and substrates to ensure they are properly supported, braced, and anchored; and are within flatness tolerances required by metal panel manufacturer.

C. Do not begin installation until substrates have been properly prepared.
   1. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
   2. Verify compatibility of different metallic surfaces in contact with each other to protect against electro-chemical corrosion

3.02 PROCEED WITH INSTALLATION ONLY AFTER UNSATISFACTORY CONDITIONS HAVE BEEN CORRECTEDPREPARATION

A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

B. Clean substrates of projections and substances detrimental to application.

C. Prime and back-prime lumber and moldings to be painted, including both faces and edges, except faces that are factory primed. Cut to required lengths and prime ends. Comply with requirements in Division 09, Section "Painting"

D. Do not use caulking, gaskets or sealants on panel face or edges.

E. Prepare surfaces using the methods recommended by the manufacturer.

3.03 PANEL INSTALLATION & REPLACEMENT

A. Protect all sub-surfaces with appropriate weather barrier prior to mounting the rainscreen sub-frame. Refer to manufacturer's guide or visit www.prodema.com.

B. All Prodema PRODEX panels must maintain a minimum 1" unobstructed vertical airspace to ensure proper air circulation. Refer to manufacturer's guide or visit www.prodema.com.

C. All ventilated facades must maintain a minimum opening of ¾" (20mm) at base and top of walls and around perimeter of soffits to promote proper airflow (i.e. convection).

D. Gap (Joint space) along all panel edges: > ¼" (6mm). Consult manufacturer for special gap conditions.

E. Cutting: Using a static circular saw with moving blade at 4000 – 6000 RPM is strongly recommended.
   1. A sharp tungsten carbide or diamond edge blade must be used to prevent splintering and affecting the face of the panel.
   2. Circular Saw: Cut panels with finished face up at a rate of approximately 20-60 ft./min.
   3. You may lightly sand cut edges to ensure a clean, crisp edge to the protective coating. Do not sand panel face.
   4. No finishing or sealing required after cutting.

F. Prior to mounting, pre-drill holes per instruction on manufacturer's technical catalog.

G. All panels in excess of 16" wide must be supported by a minimum of three horizontal guide rails. These measurements represent the maximum distances between hanging hooks and guide rails.

3.04 STANDING AND RUNNING TRIM INSTALLATION

A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long, except where necessary. Stagger joints in adjacent and related standing and running trim. Miter at returns and outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.

1. Leave 1/8-inch gap at trim and corners unless otherwise recommended by manufacturer, and apply sealant.
2. Butt joints only over framing or blocking, nailing top and bottom on each side and staggering joints in subsequent courses.
3. Install prefabricated corners as recommended by manufacturer of materials.

3.05 ADJUSTING

A. Replace exterior finish carpentry that is damaged or does not comply with requirements. Interior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

3.06 CLEANING

A. Clean interior finish carpentry on exposed and semi-exposed surfaces. Restore damaged or soiled areas and touch up factory-applied finishes, if any.

3.07 PROTECTION

A. Protect installed products from damage from weather and other causes during construction.

B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.
   1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

C. Protect panels from damage during remainder of construction period. Upon determination of responsibility, repair or replace damaged metal panels and trim to the satisfaction of the Architect and / or Owner.

D. Panels damaged by construction operations that cannot be repaired to satisfaction of the Architect shall be replaced.

END OF SECTION 06 20 23

SECTION 06 42 00 - WOOD PANELING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Flush wood paneling (wood-veneer wall and ceiling surfacing).
   2. Wood furring, blocking, shims, and hanging strips for installing flush wood paneling unless concealed within other construction before paneling installation.
   3. Shop finishing of flush wood paneling.

1.03 RELATED REQUIREMENTS

A. Refer to Division 01 for Volatile Organic Compound (VOC) Content Restrictions.

B. Section 06 10 00 – Rough Carpentry: Support framing, grounds, and concealed blocking.

1.04 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; current edition.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product, including panel products adhesives and finishing materials and processes.

B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories. Show location of paneling, large-scale details, attachment devices, and other components. Include dimensioned plans and elevations.
   1. For paneling veneered in fabrication shop, show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
   2. Minimum Scale of Detail Drawings: 1-1/2 inch to 1 foot.
   3. Provide the information required by AWI/AWMAC/WI Architectural Woodwork Standards.

C. Samples:
   1. Submit two samples of finished wood, 24 x 24 inch in size, illustrating wood grain and specified finish.
   2. Submit two samples of wood trim, 24 inch long.

1.06 INFORMATIONAL SUBMITTALS

A. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.07 QUALITY ASSURANCE

A. Fabricator Qualifications:
   1. Certified participant in AWI's Quality Certification Program.
   2. Company specializing in manufacturing the products specified in this section with minimum 5 years of documented experience.
   3. Single Source Responsibility: Provide and install this work from single fabricator.

4. Single Source Supply: All wood veneer shall be from the same source.

1.08 FIELD CONDITIONS

A. Protect work from moisture damage.

B. Environmental Limitations: Do not deliver or install paneling until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.01 PANELING, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of flush wood paneling (wood-veneer wall surfacing) indicated for construction, finishes, installation, and other requirements.
   1. Provide labels and certificates from AWI certification program indicating that paneling, including installation, complies with requirements of grades specified.

2.02 FLUSH WOOD PANELING (WOOD-VENEER WALL SURFACING)

A. Grade: AWI Premium Grade.

B. Wood Species and Cut for Transparent Finish: White oak, rift.

C. Certified Wood: Wood and composite wood components of flush wood paneling shall be certified as "FSC Pure" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and FSC STD-40-004, "FSC Standard for Chain of Custody Certification."

D. Matching of Adjacent Veneer Leaves: Slip match.

E. Veneer Matching within Panel Face: Center-balance match.

F. Matching of Adjacent Veneer Leaves and within Panel Face: Slip match.

G. Panel-Matching Method: Match panels within each separate area by the following method:
   1. Premanufactured sets used full width.
   2. Premanufactured sets selectively reduced in width.
   3. Sequence-matched, uniform-size sets.

H. Vertical Panel-Matching Method: Continuous match; veneer leaves of upper panels are continuations of veneer leaves of lower panels.

I. Fire-Retardant-Treated Paneling: Panels shall consist of wood-veneer and fire-retardant particleboard or fire-retardant, medium-density fiberboard. Panels shall have a flame-spread index of 25 or less and a smoke-developed index of 450 or less per ASTM E 84 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.

J. Panel Core Construction: Fire-retardant particleboard or fire-retardant, medium-density fiberboard.
   1. Thickness: 3/4 inch.

K. Exposed Panel Edges: Inset solid-wood or wood-veneer matching faces.

L. Panel Reveals: Matte black plastic laminate or painted black hardwood spline for 1/8" wide reveal in locations as shown in drawings.

M. Outside Corners: Mitered and splined.

N. Assemble panels by gluing and concealed fastening.

2.03 MATERIALS

A. Materials, General: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.

B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.

C. Medium-Density Fiberboard: ANSI A208.2, made with binder containing no urea formaldehyde.
   1. Particleboard: ANSI A208.1Grade M-2, made with binder containing no urea formaldehyde; composed of wood chips, medium density, made with waterproof resin binders; of grade to suit application; sanded faces.

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

E. Adhesives: Type suitable for intended purpose, complying with applicable air quality regulations. Do not use adhesives that contain urea formaldehyde.

F. Fasteners: Of size and type to suit the application.

2.04 INSTALLATION 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.

C. VOC Limits for Installation Adhesives: Use products 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. Multipurpose Construction Adhesives: 70 g/L.
   3. Contact Adhesive: 80 g/L.
   4. Special-Purpose Contact Adhesive (contact adhesive that is used to bond melamine-covered board, metal, unsupported vinyl, rubber, or wood veneer 1/16 inch or less in thickness to any surface): 250 g/L.

2.05 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Complete fabrication, including assembly and finishing, 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, plumbing fixtures, 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.

D. Finish exposed edges of panels as specified by grade requirements.

2.06 SHOP FINISHING

A. General: Finish paneling at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing paneling, as applicable to each unit of work.
   1. Backpriming: Apply two coats of sealer or primer, compatible with finish coats, to concealed surfaces of paneling.

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

D. Apply wood filler in exposed nail and screw indentations.

E. On items to receive transparent finishes, use wood filler that matches surrounding surfaces and is of type recommended for the applicable finish.

F. Finish work in accordance with AWI/AWMAC/WI Architectural Woodwork Standards, Section 5 - Finishing for Grade specified and as follows:
   1. Transparent Finish:
      a. Grade: Premium.
      b. System - 12, Polyurethane, Water-based.
      c. Treatment in first subparagraph below helps prevent blotchiness with wiping stains; it is optional with AWI.
      d. Wash Coat for Stained Finish: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
      e. Staining: Color as Selected by Architect.
      f. Finish: AWI Finish System - 5, conversion varnish.
      g. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
      h. Sheen: Semigloss, 46-60 gloss units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.01 PREPARATION

A. Verify that field measurements are as indicated.

B. Verify adequacy of backing and support framing.

C. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

D. Before installation, condition paneling to average prevailing humidity conditions in installation areas.

3.02 INSTALLATION

A. Install work in accordance with AWI/AWMAC/WI Architectural Woodwork Standards requirements for grade indicated.

B. Do not begin installation until wood materials have been fully acclimated to interior conditions.

C. Install paneling level, plumb, true, and straight with no distortions. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches. Install with no more than 1/16 inch in 96-inch vertical cup or bow and 1/8 inch in 96-inch horizontal variation from a true plane.
   1. For flush paneling with revealed joints, install with variations in reveal width, alignment of top and bottom edges, and flushness between adjacent panels not exceeding 1/32 inch.

D. Anchor paneling to supporting substrate with concealed panel-hanger clips. Do not use face fastening.

E. Where necessary to cut and fit on site, scribe work abutting other components. Do not use additional overlay trim to conceal gaps.

F. Set exposed fasteners, fill with wood filler, and finish to match panel finish.

G. Touch up damaged finish to match original, using materials provided by fabricator; replace components that cannot be refinished like new.

END OF SECTION 06 42 00

SECTION 07 11 13 - BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Cold-applied, emulsified-asphalt dampproofing.
      a. At grade beams below grade, with drainage course to french drain.
      b. At retaining walls, with free draining aggregate and french drain.

B. Related Sections include the following:
   1. Division 04 Section - Unit Masonry Assemblies.
   2. Division 07 Section Self Adhering Sheet Waterproofing, for waterproofing system at building grade beams and walls below grade.
   3. Division 07 Sections for other waterproofing, air barrier, and weather barrier systems.
   4. Division 07 Section - Sheet Metal Flashing and Trim.
   5. Division 31 and 33 Sections for filter fabric, free draining aggregate and french drains.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.04 FIELD CONDITIONS

A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.

B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has cured.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

A. Source Limitations: Obtain primary dampproofing materials and primers from single source from single manufacturer. Provide protection course molded-sheet drainage panels and auxiliary materials recommended in writing by manufacturer of primary materials.

B. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction unless otherwise required.

2.02 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

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. BASF Construction Chemicals - Building Systems; Sonneborn Brand Products.
   2. ChemMasters, Inc.
   3. Euclid Chemical Company (The); an RPM company.
   4. Henry Company.
   5. Karnak Corporation.

6. Koppers Inc.
7. Malarkey Roofing Products.
8. Meadows, W. R., Inc.

B. Basis of Design shall be a heavy bodied, non-sag coating with short fibers for application with Fibered Brush, Roller or Spray, in compliance with ASTM D-1227, Type II, Class 1, equal to BASF's "MasterSeal 615".

2.03 AUXILIARY MATERIALS

A. General: Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.

B. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.

C. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.

D. Patching Compound: Asbestos-free fibered mastic of type recommended in writing by dampproofing manufacturer.

E. Protection Course at grade beams below grade: ASTM D 6506, 1/8-inch- thick, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners.

F. Protection Course at retaining walls: Smooth-surfaced roll roofing complying with ASTM D 6380, Class S, Type III.

2.04 MOLDED-SHEET DRAINAGE PANELS

A. Molded-Sheet Drainage Panel: Comply with Division 33 Section - Subdrainage.

B. Geotextile-Faced, Molded-Sheet Drainage Panel: Composite subsurface drainage panel consisting of a 40% post-industrial recycled polypropylene drainage core of fused, entangled filaments, with a geocomposite fabric facing bonded to one side with an opening size not exceeding No. 70 sieve, and a vertical flow rate of 9 to 22 gpm per ft. Provide termination bar and sheet metal flashing cap for panels installed with top edge above grade. The Basis of Design product shall be "Enkadrain 3611R", as manufactured by Colband Inc., Enka, NC (800) 365-7391.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions with Applicator present, for compliance with requirements for surface smoothness, surface moisture, and other conditions affecting performance of bituminous dampproofing work.

B. Proceed with application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.

B. Clean substrates of projections and substances detrimental to the dampproofing work; fill voids, seal joints, and remove bond breakers if any, as recommended in writing by prime material manufacturer.

C. Apply patching compound to patch and fill tie holes, honeycombs, reveals, and other imperfections.

3.03 APPLICATION, GENERAL

A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and drying time before backfilling unless more stringent requirements are indicated.
   1. Apply dampproofing to provide continuous plane of protection.
   2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.

B. Where dampproofing footings and foundation walls, apply from finished-grade line to bottom of grade beam
   1. At footings, extend over top of footing and down a minimum of 6 inches over outside face of footing.
   2. Extend dampproofing 12 inches onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
   3. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an 8-inch- wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.

C. Where dampproofing exterior face of inner wythe of exterior masonry cavity walls, lap dampproofing at least 1 inch onto flashing, and 1/4 inch onto masonry reinforcement, veneer ties, and other items that penetrate inner wythe.
   1. Extend dampproofing over outer face of structural members and concrete slabs that interrupt inner wythe.
   2. Lap dampproofing at least 1/2 inch onto shelf angles supporting veneer.
   3. At metal flashings installed with termination bar to exterior face of masonry, strip in bituminous felts. Lap felts at least 2" over metal flashing and continuously seal top of felt strip to masonry with dampproofing.

D. Where dampproofing of cavity walls adjoins other dampproofing or air barrier or weather barrier materials, coordinate with adjacent material installer to provide continuous weatherproofing barrier and to avoid incompatible materials coming in contact with each other. Take care not to apply or spill dampproofing on surfaces to receive incompatible weatherization membranes.

3.04 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

A. Concrete Foundations: Apply one fibered brush or spray coat at not less than 3 gal./100 sq. ft. or one trowel coat at not less than 4 gal./100 sq. ft..

B. Unexposed Face of Masonry Retaining Walls: Apply primer as recommended by manufacturer for substrates indicated, and one brush or spray coat at not less than 1.25 gal./100 sq. ft.

3.05 INSTALLATION OF PROTECTION COURSE

A. Where indicated, install protection course over completed-and-cured dampproofing. Comply with dampproofing-material and protection-course manufacturers' written instructions for attaching protection course.
   1. Install protection course within 24 hours of installation of dampproofing (while coating is tacky) to ensure adhesion.

3.06 INSTALLATION OF MOLDED-SHEET DRAINAGE PANELS

A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall substrate, according to manufacturer's written instructions. Use adhesives or other methods that do not penetrate dampproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.
   1. Install protection course before installing drainage panels.

B. Where indicated to extend above grade, install top edge of drainage panel with mechanically attached termination bar and prefinished sheet metal flashing cap.

3.07 CLEANING

A. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 07 11 13

SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Provide all building insulation as shown on the drawings and as herein specified.

B. Related Sections include the following:
   1. Division 04 Section – Masonry sections, for coordination in marking centerlines of studs on the face of exterior continuous insulation for subsequent installation of ties and anchors.
   2. Division 05 Section - Architectural Metal Decking.
   3. Division 05 Section - Cold Formed Metal Framing, for coordination with framing for packing cavities with Batt insulation and for installation of thermal envelope continuous insulation.
   4. Division 06 Section - Sheathing.
   5. Division 07 Section - Air Barriers.
   6. Division 07 Section - Fire Safing, for mineral fiber insulation used for fire containment or for fire rated construction.
   7. Division 09 Section - Gypsum Board Assemblies.
   8. Division 09 Section - Acoustic Insulation.
   9. Division 21 and 23 Sections, for piping and mechanical ductwork insulation.

1.03 QUALITY ASSURANCE

A. Design Criteria:
   1. Thermal Resistance: R-Value designations indicated in accordance with ASTM C-518 is the thermal resistance of the insulation only.
   2. Fire Resistance: Material shall have a Class B fire rating less than 75 as tested by ASTM E-84.

B. Paper faced batt insulation shall not be used. Foil-faced insulation shall not be used except as specifically prescribed herein.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer's original packages, clearly marked with brand name, type and R-Value.

B. Store materials in area protected from weather, moisture and damage, remove any damaged materials from the site.

1.05 SUBMITTALS

A. Samples of materials and complete product literature (with documented R-Values) submitted for approval to the Architect prior to ordering materials.

B. Provide Dew Point Analysis to confirm insulation thickness and location of weather barrier for particular building site (inside or outside face of insulation).

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with project requirements, Manufacturer's offering Products which may be incorporated into the work include the following:
   1. CertainTeed Corporation, Valley Forge, PA. (215) 341-7000.
   2. Owens-Corning Fiberglass Corporation, Toledo, OH. (419) 248-8000.
   3. Schuller International, Insulation Division, Denver, CO. (800) 654-3103.
   4. Johns Manville, Denver, CO.
   5. Knauf Insulation, Shelbyville, IN.
   6. Dow Chemical Company, Midland, MI.
   7. ROXUL, Inc., Milton, Ontario

B. Division 01 Section - Product Requirements: Product options and substitutions. Substitutions: Permitted.

2.02 MATERIALS

A. Glass Fiber Batt Insulation: Unfaced with flame spread of 25 minutes in compliance with ASTM C665, Type III, Class A and ASTM 136.
   1. Provide at 6" stud construction in exterior walls and between conditioned and unconditioned spaces, unless otherwise noted: Nominal 6-1/4" thick batt insulation with an R-value of 19.
   2. Provide at 3-5/8" stud construction in exterior walls and between conditioned and unconditioned spaces, unless otherwise noted: Nominal 3-1/2" thick batt insulation with an R-value of 13.

B. Mineral Batt Insulation: Unfaced, ASTM C 665, Type I; consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics. Use mineral batts where insulation built into concealed cavities in framing may become wet prior to closing the building envelope.
   1. Provide at 6" stud construction in exterior walls and between conditioned and unconditioned spaces, unless otherwise noted: Nominal 6" thick batt insulation with a minimum R-value of 19.
   2. Provide at 3-5/8" stud construction in exterior walls and between conditioned and unconditioned spaces, unless otherwise noted: Nominal 3-1/2" thick batt insulation with a minimum R-value of 13.
   3. Post-consumer plus 1/2 pre-consumer recycled content by weight not less than 70%. Binder with no added formaldehyde. Insulation shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Owens Corning / Thermafiber "UltraBatt", or equal.

A. Continuous Insulation at exterior cavity wall Construction: Semi-rigid mineral wool insulation board that is water repellent and meets ASTM C612, IVA. Thermafiber RainBarrier 45 Insulation, or approved equal.
   1. R-Value: 4.3 per inch of thickness. Thickness(es) as noted on Drawings.
   2. Facing: Unfaced.
   3. Density: 4.5 pounds per cubic foot.
   4. Surface Burning Characteristics: Flame Spread 0, Smoke Developed 0.
   5. Moisture Resistance: Absorbs less than 0.03% by volume, ASTM C 1104.
   6. Non-Corrosive, ASTM C 665.

B. Continuous Insulation at exterior cavity at dry joint rain screen exterior finishes: High density, semi-rigid mineral wool insulation board that is water repellent and meets ASTM C612, IVA. Thermafiber RainBarrier HD Insulation, or approved equal.
   1. R-Value: 4.3 per inch of thickness. Thickness(es) as noted on Drawings.
   2. Facing: Unfaced.
   3. Density: 6.0 pounds per cubic foot.
   4. Surface Burning Characteristics: Flame Spread 0, Smoke Developed 0.
   5. Moisture Resistance: Absorbs less than 0.03% by volume, ASTM C 1104.
   6. Non-Corrosive, ASTM C 665.
   7. Color: Standard
   8. Pre-consumer recycled content: 70%.

2.03 AUXILIARY INSULATING MATERIALS

A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates. Adhesive shall be compatible with air barrier membrane.

B. Provide insulation fasteners as recommended by manufacturer for substrates and conditions indicated.

PART 3 - EXECUTION

3.01 INSPECTION AND COORDINATION

A. Examine areas receiving insulation work to insure work of preceding trades is completed. Check surfaces to see that they are uniform in place, free from mortar droppings, grease, oil or other debris which would affect proper insulation. Application constitutes acceptance of substrate conditions.

B. Coordinate marking centerline of studs on exterior face of continuous insulation as required for insulation installation and for subsequent fastener installation by other trades.

3.02 GENERAL INSTALLATION

A. Prepare surfaces using methods recommended by manufacturer for achieving the best result for the substrate under the project conditions.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.

C. Insulation installed in accordance with current printed recommendations of insulation manufacturer as specified.

D. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

E. Install batt insulation without visible voids, gaps or separations. Place insulation in Cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members. Cut and trim insulation neatly to fit spaces without laps, bulges or folds. Use batts free of rips and tears.
   1. Coordinate with light gauge metal stud installer to pack batt insulation in light gauge metal construction as it is being constructed, that will be inaccessible to install batts when completed (headers, stud packs, etc). Use mineral batts where insulation may get wet or be exposed to weather prior to closing the building envelope.

F. Fit insulation tight within spaces and tight to and behind mechanical and electrical wiring.

G. Mineral Fiber Semi-Rigid Board Continuous Insulation:
   1. Continuous insulation at exterior walls shall be adhered or attached in place per manufacturer's recommendations for the substrates and conditions indicated. Use of friction fit only between furring channels is not an acceptable installation.
      a. Construction adhesive must be recommended by its manufacturer for use with the continuous insulation board and compatible with air barrier membrane or dampproofing mastic with which it will come in contact.
      b. Mechanical fasteners installation shall be coordinated with air barrier manufacturer's requirements for fastener penetrations through the air barrier, as applicable.
   2. Fit courses of insulation with edges butted tightly in both directions. Press units firmly against substrates indicated.
   3. Press units firmly against sheathing, or other substrates. Stagger joints. Make insulation continuous. Fill all voids.
   4. Coordinate placement of insulation with location of masonry veneer anchors, metal Zee furring, and similar construction.
   5. Cut and fit insulation tight to protrusions or interruptions to insulation plane.

3.03 INSTALLATION OF GENERAL BUILDING INSULATION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Install batt insulation in cavities formed by framing members according to the following requirements:
   1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
   2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
   3. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
   4. Fill roof expansion joints with batt insulation to equal or greater R-value of insulation at roof surface.

C. Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:
   1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to

insulation manufacturer's written instructions for insulation type, thickness, and application indicated.

2. Apply insulation standoffs to each spindle to create cavity width indicated between concrete substrate and insulation.
3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation below indicated thickness.
4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

3.04 FIELD QUALITY CONTROL

A. Comply with requirements of Authorities having jurisdiction for inspection of installation of insulation, and with requirements of commissioning agent. Notify respective parties and schedule required inspections prior to closing walls or cavities containing thermal insulation.

3.05 CLEANING

A. Comply with requirements of Division 01, Section "Construction Waste Management".

END OF SECTION 07 21 00

SECTION 07 26 00 - VAPOR BARRIER MEMBRANE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes:
   1. Vapor barrier film beneath slabs on grade and slabs on void forms.
   2. Vapor barrier over grade in crawl space.

B. Related Sections:
   1. Division 03 Section - Cast-in-Place Concrete.
   2. Division 31 Section - Earthwork.

1.03 COORDINATION

A. Coordinate installation with scheduled concrete pours to avoid delays. Make provision for installation of work by other trades.

1.04 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM E 1745- 11 Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
   2. ASTM E 154- 08 Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
   3. ASTM F 1249-06 (2011) Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor.
   4. ASTM D 882-10 Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
   5. ASTM D 1709-09 Standard Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method.
   6. ASTM E 1643- 11 Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

B. American Concrete Institute (ACI):
   1. ACI 302.2R-06 Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.

1.05 SUBMITTALS

A. Division 01 Section - Submittal Procedures: Procedures for submittals.

B. Quality Control / Assurance:
   1. Summary of test results as per paragraph 8.3 of ASTM E 1745.
   2. Manufacturer’s literature.
   3. Manufacturer’s installation instructions for placement, seaming and penetration repair.

C. Provide 12" x 12" samples of vapor barrier material and samples of tape for joints.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with project requirements, manufacturer's offering Products which may be incorporated in the Work include the following:
   1. Basis of Design: Stego Industries LLC (281) 367-0040 www.stegoindustries.com.
   2. Raven Industries (800) 635-3456 www.ravenefd.com.
   3. Reef Industries (713) 507-4250 www.reefindustries.com.

B. Division 01 Section - Product Requirements: Product options and substitutions. Substitutions: Not Permitted

2.02 MATERIALS

A. Membrane Film:
   1. Qualities:
      a. Maintain a permeance of less than 0.01 Perms [grains/(ft^2 · hr · inHg)], as tested in accordance ASTM E-154, with mandatory conditioning tests, per ASTM E1745 Section 7.1 (7.1.1-7.1.5).
      b. Strength: ASTM E 1745 Class A.
      c. Thickness: 15mils minimum, in accordance with ACI 302.2R-06.
      d. Provide third party documentation that all testing was performed on a single production roll per ASTM E1745 Section 8.1.
   2. Available products:
      a. Basis of Design: Stego Wrap Vapor Barrier (15 mil) by Stego Industries.
      b. Vapor Block (15 mil) by Raven Industries.
      c. VaporGuard (15 mil) by Reef Industries.
      d. No Substitutions.
   3. At crawl space application, use manufacturer's minimum 15 mil thickness crawl space rated product.

B. Accessories:
   1. Seams Tape: Stego Tape by Stego Industries LLC, or membrane manufacturer's standard tape for applications indicated.
   2. Penetration Repair: Stego Mastic and Stego Tape by Stego Industries LLC, or membrane manufacturer's standard product for applications indicated.
   3. Perimeter / Edge Seal: Crete Claw, Stego Tack Tape and Stego Term Bar by Stego Industries LLC, or membrane manufacturer's standard product for applications indicated.
   4. For crawl space installation, use pins, adhesives, double sided mounting tape, termination bars, and caulking as recommended by membrane manufacturer for the applications indicated.

PART 3 - EXECUTION

3.01 PREPARATION

A. Do not proceed until fill is level and without voids, and plumbing and electrical rough-ins are complete.

3.02 INSTALLATION - GENERAL

A. Install Vapor Barrier in accordance with ASTM E 1643-11:
   1. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete placement and face laps away from the expected direction of the placement whenever possible.

2. Extend vapor barrier over footings and grade beams to a distance acceptable to the structural engineer or stop at impediments such as dowels and waterstops.
3. Seal vapor barrier to slab perimeter/edge using Stego Crete Claw and remove dirt, debris, and mud from Crete Claw prior to concrete placement.
4. Alternate: Seal vapor barrier to footing/grade beam with double sided tape, termination bar, or both.
5. Overlap joints 6 inches and seal with manufacturer's tape.
6. Apply tape/Crete Claw to a clean and dry vapor barrier.
7. Seal all penetrations (including pipes) per manufacturer's instructions.
8. No penetration of the vapor barrier is allowed except for reinforcing steel and permanent utilities.
9. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 6 inches and taping all sides with tape.

B. Vapor Barrier over void boxes:
1. Cartons for slabs shall have protective cover board with Stego 15 mil and Stego Crete-Claw Tape.
2. Stego Crete-Claw Tape Instructions: Overlap seams a minimum of 6 inches. Seal all seams in Stego Wrap using Crete-Claw Tape.
3. Install Crete-Claw Tape on the entire perimeter of the Stego Wrap Installation.
4. Install additional Crete-Claw Tape if required.

3.03 INSTALLATION - CRAWL SPACE

A. Install membrane over grade in crawl space according to manufacturer's installation instructions for crawl space application and as follows:

B. Wrap vapor barrier continuously up face of perimeter grade beams to within approximately 6" of top of grade beam. Wrap up sides of interior footings, piers and similar penetrations 6"-12". Form boots from membrane material at pipes and similar penetrations as recommended by membrane manufacturer. Attach and seal top of membrane to vertical surfaces.
1. Attach membrane to vertical surfaces with adhesives, double sided tape, termination bars, caulking, and other materials and accessories as recommended by membrane manufacturer.

C. Install membrane without folds or creases that would trap water or impede crawl space drainage, but with enough slack to prevent material from being stretched by normal service traffic through the crawl space.

D. Where recommended by manufacturer and where required to hold membrane in place, install membrane with manufacturer's recommended pins into grade below. Seal penetrations with seam tape or by manufacturer's recommended method.

3.04 PROTECTION

A. Protect completed membrane from damage. Prior to pouring concrete, inspect membrane for punctures or damage and repair as required.
1. At crawl space applications, inspect membrane for damage prior to substantial completion. Repair damaged areas per membrane manufacturer's instructions.

END OF SECTION 07 26 00

SECTION 07 27 27 - FLUID-APPLIED MEMBRANE AIR BARRIER

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:
   1. Fluid-applied membrane air barrier, vapor permeable.

B. Related Sections include the following:
   1. Division 06 and/or 09 Sections for coordination with sheathing installation requirements.
   2. Division 07 Sections for coordination with other weatherization systems of the building envelope.
   3. Division 07 Section - Sheet Metal Flashing and Trim.
   4. Division 07 Section(s) for rainscreen cladding system(s) installed in front of fluid applied membrane air barrier.
   5. Division 07 Section - Expansion Control for expansion-joint assemblies that interface with air barriers.

1.03 REFERENCES

A. ASTM E2357: Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.

B. ASTM E2178: Standard Test Method for Air Permeance of Building Materials.

C. ASTM E283: Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

D. ASTM E1677 Specification for Air Retarder (AR) Material or System for Low-Rise Framed Building Walls.

E. ASTM E330: Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

F. ASTM E331: Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

G. ASTM E96: Water Vapor Transmission of Materials.

H. CGSB 37-GP-56M: Membrane, Modified, Bituminous, Prefabricated, and Reinforced.

I. AMMA 2400: Standard Practice for Installation of Windows with a Mounting Flange in Stud Frame Construction.

J. ASTM E 2112: Standard Practice for Installation of Exterior Windows, Doors and Skylights.

K. ASTM D 5590: Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay.

1.04 PERFORMANCE REQUIREMENTS

A. General: Air barrier shall be capable of performing as a continuous vapor- permeable air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation and water penetration. Air barrier assemblies shall be capable of

accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

1. Air barrier shall be system approved by manufacturer for use with the open faced rain screen cladding system(s) specified in other Sections of these specifications. Air barrier shall be UV resistant, designed to perform for the lifetime of the material without degradation in performance due to UV radiation exposure through the open faced cladding system(s).

B. Junctions of air barrier shall be coordinated with other adjacent weatherization systems for complete weather tight building envelope.

C. Entire system visible through open faced cladding system(s) shall be consistent uniform color.

1. Color: Black, or other color as approved in writing by Architect.
2. Visible surface shall be of consistent quality that in Architect's opinion does not adversely affect aesthetic quality of the installation, to quality standards as per approved mock-up.

1.05 ACTION SUBMITTALS

A. Product Data: For each product indicated

B. Shop Drawings: Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strip, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.

1. Include details of interfaces with other materials that form part of air barrier.

1.06 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Qualification data.

C. Product test reports.

1.07 QUALITY ASSURANCE

A. Applicator Qualifications: Submit document stating the applicator of the primary air barrier membranes specified in this section is qualified by the manufacturer as suitable for the execution of the Work.

B. Maintain a copy of manufacturer's written installation instructions on site. Allow access to work site by air barrier membrane manufacturer's representative to inspect installation.

C. Single Source Responsibility: Components used shall be sourced from one manufacturer, including sheet membrane, air barrier sealants, primers, mastics, and adhesives. Obtain air barrier materials from a single manufacturer regularly engaged in manufacturing the product.

1. Provide products which comply with all federal, state and local regulations controlling use of volatile organic compounds (VOCs).

D. Mockups: Before beginning installation of air barrier, build mockups of exterior wall assembly, 100 sq. ft., incorporating backup wall construction, external cladding, window, door frame and sill, insulation, and flashing to demonstrate surface preparation, crack and joint treatment, and sealing of gaps, terminations, and penetrations of air barrier membrane.

1. Coordinate construction of mockup to permit inspection by Owner's testing agency of air barrier before external insulation and cladding is installed.
2. Include junctions with roofing membrane and other adjacent weatherization systems as applicable.

3. Test mock-up for air and water infiltration to conform with Section 01400 - Quality Control, in accordance with ASTM E783 and ASTM E1105.

E. Coordination Meeting:
   1. Contractor shall convene a coordination meeting at least one week prior to commencing Work of this section.
   2. Ensure all contractors responsible for creating a continuous air tight envelope are present. Invite representatives of air barrier and weatherization system(s).
   3. Discuss interface of all materials in contact with air barrier and weatherization systems. Confirm requirements to ensure air tight and weather tight installation in compliance with specifications and warranty requirements.
   4. Record and distribute minutes to all parties and copy Architect.

F. Contractor to verify compliance for Volatile Organic Compounds (VOC) limitations of products comply with all federal, state and local regulations controlling use of volatile organic compounds (VOCs).

1.08 DELIVERY, STORAGE AND HANDLING

A. Refer to current Product MSDS for proper storage and handling. Store and handle materials in compliance with manufacturer's recommendations, and within manufacturer's temperature limits.

B. Deliver materials to the job site in undamaged and original packaging indicating the name of the manufacturer and product.

C. Store role materials on end in original packaging. Protect rolls from direct sunlight until ready for use.

D. .Keep solvent away from open flame or excessive heat.

1.09 WARRANTY

A. Provide manufacturer's standard 10-year material warranty.
   1. Coordinate with manufacturer for required inspections by manufacturer's representative.

PART 2 - PRODUCTS

2.01 FLUID-APPLIED MEMBRANE AIR BARRIER SYSTEM

A. Fluid-Applied, Vapor-Permeable Membrane Air Barrier: synthetic polymer membrane. Basis of Design Products: Subject to compliance with requirements, provide the following, or approved comparable product by another manufacturer:
   1. Primary air and rain barrier membrane for temperatures above 40 degrees F and rising: Air-Bloc 33 MR manufactured by Henry; a UV resistant one component water based elastomeric emulsion membrane, fire resistant and designed for permanent exposure, trowel or spray applied, having the following characteristics:
      a. Air permeability: 0.0016 CFM/ft^2 @ 1.6 lbs/ft^2 to ASTM E2178 and ASTM E283 and have no increased air leakage when subjected to a sustained wind load of 10.5 lbs/ft^2 for 1 hour and gust wind load pressure of 62.8 lbs/ft^2 for 10 seconds when tested at 1.6 lbs/ft^2 to ASTM E331.
      b. Water vapor permeance: 11.6 perms to ASTM E96 Method B when tested at 58 mils dry film thickness.
      c. Rating 0 - No fungal growth as tested to ASTM D 5590
      d. Surface Burning: NFPA Class A, UBC Class 1, Flame Spread 25, Smoke Developed 85 to ASTM E84.
      e. UV Resistance: Passes 73 Cycles to ASTM D4799 Cycle B (Q-UV).
      f. Low temperature flexibility and crack bridging: Pass -4 degrees F to ASTM C836.

g. Long term flexibility: Pass to CGSB 71-GP-24M.
h. Watertightness (CGSB 37-GP-56M): Pass.

2. Self-adhering vapor permeable air barrier membrane for head and jamb of wood frame windows, transition and joint treatment: manufacturer's recommended self-adhering membrane consisting of a microporous film laminate, backed with a specially applied adhesive, which allows water vapor to permeate through while acting as a barrier to air and rain water. Membrane shall have the following physical properties:
   a. Air leakage: <0.002 CFM/ft^2 @ 1.6 lbs/ft^2 to ASTM E283-91.
   b. Water vapor permeance: 37 perms to ASTM E96.
   c. Membrane Thickness: 17 mils.
   d. Low temperature flexibility -40 degrees F: Pass to ASTM D3111.
   e. Hydrostatic Water Resistance: 18 psi ASTM D751 Procedure A.

2.02 AUXILIARY MATERIALS

A. General: Auxiliary materials recommended by air barrier manufacturer for intended use and compatible with air barrier membrane. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid primer recommended for substrate by manufacturer of air barrier material.

C. Adhesives: Manufacturer's standard adhesives for products and substrates indicated, and complying with performance criteria.

D. Joint Reinforcing Strip: Manfuacturer's recommended self adhering membrane, or where acceptable to manufacturer for applications and warranty indicated, reinforcing strip may be air barrier manufacturer's glass-fiber-mesh tape.

E. Substrate Patching Membrane: Manufacturer's standard trowel-grade substrate filler.

F. Preformed Silicone-Sealant Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.

G. Penetration and Termination Sealant: Manufacturer's recommended medium modulus polymer modified sealing compound having the following physical properties:
   1. Compatible with sheet air barrier, roofing and waterproofing membranes and substrates.
   2. Complies with Fed. Spec. TT-S-00230C, Type II, Class A
   3. Complies with ASTM C 920, Type S, Grade NS, Class 25
   4. Elongation: 450 - 550%
   5. Remains flexible with aging
   6. Seals construction joints up to 1 inch wide.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and conditions are ready to accept the Work of this section. Commencement of the Work or any parts thereof shall constitute acceptance of the prepared substrates.

B. All surfaces must be sound, dry, clean and free of oil, grease, dirt, excess mortar or other contaminants. Fill voids, gaps and spalled areas in substrate to provide an even plane. Strike masonry joints flush.

C. Where curing compounds are used they must be clear resin based without oil, wax or pigments.

D. Do not proceed with application of air barrier membrane when rain is expected within 24 hours.

E. Condition materials prior to application to room temperature, or as recommended by manufacturer, to facilitate handling.

3.02 SURFACE PREPARATION

A. Ensure all preparatory Work is complete prior to applying primary air barrier membrane.

B. Mechanical fasteners used to secure sheathing boards or penetrate sheathing boards shall be set flush with sheathing and fastened into solid backing.

3.03 TRANSITION STRIP INSTALLATION

A. Install strips, transition strips, and auxiliary materials according to air barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.
   1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
   2. Install butyl strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over both substrates.

B. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same day. Reprime areas exposed for more than 24 hours.

C. Connect and seal exterior wall air barrier membrane continuously to roofing membrane air barrier, concrete below-grade structures, floor-to floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

D. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

E. Apply joint sealants forming part of air barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

F. Wall Openings: Prime concealed perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply preformed silicone-sealant extrusion so that a minimum of 3 inches of coverage is achieved over both substrates. Maintain 3 inches of full contact over firm bearing to perimeter frames with not less than 1 inch of full contact.

G. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air barrier membrane with foam sealant.

H. Seal strips and transition strips around steel panel anchors with termination mastic.

I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

J. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.04 AIR BARRIER MEMBRANE INSTALLATION

A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.

B. Apply air barrier membrane to form a seal with strips and transition strips and to achieve a continuous air barrier according to air barrier manufacturer's written instructions.

C. Apply air barrier membrane within manufacturer's recommended application temperature ranges.

D. Apply primer to substrates at required rate and allow to dry as recommended by manufacturer. Limit priming to areas that will be covered by air barrier sheet in same day. Reprime areas exposed for more than 24 hours.

E. Apply a continuous unbroken air barrier to substrates according to the following minimum thickness. Apply membrane in full contact around protrusions such as masonry ties.
   1. Vapor-Permeable Membrane Air Barrier: Thickness recommended by manufacturer.

F. Apply strip and transition strip a minimum of 1 inch onto cured air membrane according to air barrier manufacturer's written instructions.

G. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.

H. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air barrier components.

3.05 FIELD QUALITY CONTROL

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

B. Inspections: Air barrier materials and installation are subject to inspection for compliance with requirements.

C. Remove and replace deficient air barrier components and retest as specified above.

3.06 PROTECTION

A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
   1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace air barrier exposed for more than 30 days.

3.07 WASTE MANAGEMENT

A. Separate corrugated cardboard in accordance with the Waste Management Plan and place in designated areas for recycling.

B. Fold up metal banding, flatten, and place in designated area for recycling.

C. Use trigger operated spray nozzles for water hoses.

D. Return solvent and oil soaked rags for contaminant recovery and laundering or for proper disposal.

E. Use the least toxic sealants, adhesives, sealers, and finishes necessary to comply with the requirements of this section.

END OF SECTION 07 27 27

SECTION 07 42 13 - METAL WALL AND SOFFIT PANELS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Work includes all labor, materials, equipment and services necessary for fabrication and installation of metal wall and soffit panels as shown on drawings and as herein specified.

B. Related Sections include the following:
   1. Division 05 Section - Cold Formed Metal Framing, for sub-girts and support framing.
   2. Division 06 Section - Sheathing.
   3. Division 07 Section - Modified Bituminous Sheet Air Barrier, for air barrier behind metal wall panels.
   4. Division 07 Section - "Roofing" Sections, and "Sheet Metal Flashing and Trim", for coordination of air barrier and terminations between metal wall panels, and roofing and parapet copings.
   5. Division 07 Section - Joint Sealers.
   6. Division 09 Section - Metal Support Systems, Gypsum Board Assemblies, for support system for metal soffit panels.
   7. Division 09 Section - Painting.

1.03 REFERENCE STANDARDS

A. References in these specifications to standards, test methods and codes, are implied to mean the latest edition of each such standard adopted. The following is an abbreviated list of associations, institutions, and societies which may be used as references throughout these specifications.
   1. ASTM - American Society for Testing and Materials, Philadelphia, PA.
   2. FM - Factory Mutual Engineering and Research, Norwood, MA.
   3. NRCA - National Roofing Contractors Association, Rosemont, IL.
   4. OSHA - Occupational Safety and Health Administration, Washington, DC.
   5. SMACNA - Sheet Metal and Air Conditioning Contractors National Association, Chantilly, VA
   6. UL - Underwriters Laboratories, Northbook. IL

1.04 QUALITY ASSURANCE

A. Fabricator and erector shall demonstrate experience of a minimum of five years of related industry experience.

B. Design Criteria: Engineering panels for structural properties in accordance with the latest edition of the American Iron and Steel Institute "Cold Formed Steel Design Manual", using "effective width" concepts.

C. Metal Shapes Design Criteria: Conform to latest edition of Sheet Metal and Air Conditioning Contractors National Association (SMACNA).

D. Preliminary Roofing Conference: Before starting roof construction, conduct conference at Project site.

1. Review methods and procedures related to roof construction and sheet metal wall panels including all penetration and termination details at back side of parapets.

1.05 PERFORMANCE REQUIREMENTS

A. Material Compatibility: At panels adjacent to roofing, provide materials that are compatible with adjacent roofing materials under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

B. Testing Requirements: The roof system shall be tested in compliance with local code requirements and as follows:
   1. Wind Resistance: The system shall be tested to comply wind resistance forces per local code requirements.
   2. Physical Weathering Properties: Metal panels shall have corrosion resistance in accordance with local code requirements for the materials indicated.
   3. Fire Classification: The system shall be identified and listed for the fire class as required by local code by an approved testing agency, tested in compliance with ASTM E 108 or UL 790.

C. Structural Performance: Provide roof panels systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
   1. Wind Loads: As required by code and indicated wind rating, whichever is greater.
   2. Other Design Loads: As indicated on Drawings, where applicable.
   3. Deflection Limits: For wind loads, no greater than 1/240.

A. FM Global Listing: Provide metal panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.
   1. Fire/Windstorm Classification: Class 1A- 90
   2. Hail Resistance: VSH.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 deg F ambient; 180 deg F material surfaces.

C. Jobsite Safety: Execute all operations and provide a safe work environment in accordance with OSHA standards and regulations.
   1. Follow all industry, code, fire prevention guidelines and requirements for storage of materials, staging areas, roof access, and application means and methods.

1.06 SUBMITTALS

A. Product data and shop drawings based on the Contract Documents and field conditions of each metal panel type, profile and trim configuration to be installed.

B. Samples:
   1. Submit samples for each metal wall finish.
   2. Submit samples of each type and color of sealant.

C. Shop drawings showing profile and gauge of sheets, location and type of fasteners, location, gauges, shape and method of attachment of all trim, location and type of sealants, and any other details as may be required for a weathertight installation. Indicate field and factory applied sealant.

D. Informational Submittal: Letter from Manufacturer stating acceptance of proposed underlayment for use with their products, including anticipated service temperatures.

1.07 STORAGE AND HANDLING

A. Panels should be stored on edge in a clean dry place. One end should be slightly elevated to allow moisture to run off rather than accumulate on the faces.

B. Panels with strippable plastic film must not be stored in the open, exposed to the sun.

C. Stack pre-formed and prefinished material to prevent twisting, bending, or abrasion and to provide ventilation.

D. Prevent contact with materials during storage which may cause discoloration or staining.

E. In handling prefinished panels, lift up panels and do not slide panels when un-stacking.

1.08 FIELD CONDITIONS AND COORDINATION

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of canopies and soffit supports, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.09 WARRANTY

A. Provide manufacturer's standard twenty (20) year warranty stating architectural fluorocarbon finish will be:
   1. Free of fading of color change in excess of 6 NBS units as measured per ASTM D 2244-68;
   2. Will not chalk in excess of numerical rating of 7 when measured in accordance with standard procedures specified in ASTM D 659-74;
   3. Will not peel, crack, chip, or de-laminate.

B. Furnish written warranty signed by applicator for two year period from date of substantial completion of building covering repairs at back side of parapets as required to maintain parapets, roof and flashings in watertight conditions.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Recycled Content of Steel Products: Post-consumer recycled content plus one-half of pre-consumer recycled content not less than 35 percent.

B. Metal Wall and Soffit Panels: 22 Gauge, 12" W x 1" flush face, interlocking, galvanized steel panel with concealed fastening system and high grade hot melt elastomeric sealant to seat the adjoining panel legs, anchored to solid substrate or framing system as indicated**.** Panel shall be MBCI "Artisan I", No. L-12. Berridge "FW Metal Panels", or Centurion Industries "AL Flat Panels" shall be acceptable products.
   1. Finish at soffits: Kynar 500 finish (soffit use only) and color to match prefabricated metal canopies.
   2. Finish at parapet walls: For use exposed to direct sunlight (such as vertical applications), panel shall have Signature 300 (Kynar 500) "Cool Roof" 70% PVDF fluoropolymer resin coating in color as selected by Architect. Minimum .25 Solar Reflectance Index (SRI).

C. Aluminum Trim: Miscellaneous extruded and formed aluminum components shall match profiles of existing trim and/or as detailed on drawings.

D. Closures: Pre-molded neoprene and/or sheet metal shaped to fit the panel contour. Provide prefinished metal vent screeds at perimeter of soffit panels as indicated in Drawings.

E. Anchoring Devices: Provide spacers, fasteners, clips, angles and other devices necessary to install metal panels.

F. Accessory Materials:
   1. Sub-girts and support framing: Provide subgirts and support framing of size and configuration as detailed in Drawings and as necessary for complete installation.
   2. Panel Fasteners: Galvanized steel with washers where required.
   3. Aluminum Trim Fasteners: Exposed fasteners shall be aluminum or stainless steel. Unexposed fasteners may be cadmium or zinc plated steel in accordance with ASTM A164-55 and 165-55. Steel anchors shall be properly insulated from aluminum.
   4. Sealant: Color-coordinated, primerless silicone or high grade, non-drying butyl as recommended by panel manufacturer. Do not use sealant containing asphalt.

G. Filler: Non-solvent epoxy polyamide sealer shall be Tnemec's 62-1400, "Seam Sealer".

H. Self-Adhering, High-Temperature Underlayment: Provide in accordance with Division 07, Section "Modified Bituminous Sheet Air Barrier", and panel manufacturer's recommendations for anticipated in-service temperatures. Provide primer when recommended by underlayment manufacturer.
   1. Thermal Stability: Stable after testing at 180 deg F or where higher temperature resistance is indicated by panel manufacturer, per ASTM D 1970.
   2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F per ASTM D 1970.

PART 3 - EXECUTION

3.01 COORDINATION AND INSPECTION

A. Coordinate with other trades, prior to rough-in and penetrations, exact locations for roughing-in of components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels. Conduit, pipe and other small penetrations shall not be located in panel seams. Examine and confirm these locations again before installation to avoid conflicts.
   1. Contractor is responsible to relocate pipe and similar penetrations as required to avoid seams. Contractor shall not be due additional compensation to relocate items and make other corrections as required due to failure of Contractor to coordinate between trades.

B. Fabricator and erector are responsible for inspecting existing conditions to verify general conditions, panel profiles and panel attachments and examine all parts of existing building affecting the installation of his work.
   1. Examine sheathing and substrates to ensure they are properly supported, braced, and anchored; and are within flatness tolerances required by metal panel manufacturer.

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

3.02 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.03 PANEL INSTALLATION [& REPLACEMENT]

A. Panels indicated on drawings as damaged and therefore to be replaced shall be field cut in workmanlike manner to appropriate lengths for installation.

B. Install metal panels, fasteners, trim and related sealants in accordance with manufacturer's recommendations, approved shop drawings, and code requirements, and as may be required for a weathertight installation.

C. Remove all strippable coatings and provide a dry wipe-down cleaning of the panels as they are erected.
   1. Comply with Manufacturer's installation instructions for cleaning.

D. Install panels to interlock with adjoining panels in order to prevent water penetration and air leakage per industry standards.

E. Panels shall be installed plumb and true in proper alignment.

F. Lap Sealing: Seal side and end laps of metal panels per Manufacturer's recommendations and installation instructions.

3.04 ACCESSORY INSTALLATION

A. Dissimilar Materials: Isolate aluminum surfaces from contrasting steel or other ferrous metals using EC-1202 tape or zinc chromate paint.

B. Closures: Furnish and install closure trim profiles abutting adjacent materials, adjoining walls, etc. as required to close off cavities and where panel profile would otherwise be exposed to view. Closure shall be installed using proper adhesive and fit flush with edge of panel. Seal perimeter of closure. Coordinate installation with adjacent material installers, and painting as applicable.

C. Trim: Install trim using specified fasteners at locations shown on Drawings, or where not indicated at equal spacing as required by installation instructions and wind loading and other structural requirements.

3.05 PROTECTION AND REPAIR

A. If applicable, remove factory protective plastic coatings at time as recommended by roofing Manufacturer. Do not allow protective coatings to melt onto roof panel surfaces.
   1. For metal surfaces intended to weather or patina, wear gloves and take precautions to avoid spills, oil from hands and skin, etc. that can leave marks or cause uneven weathering of panel surfaces. Require the same of other trades working on or near panel surfaces after installation.

B. Protect panels from damage during remainder of construction period. Upon determination of responsibility, repair or replace damaged metal panels and trim to the satisfaction of the Architect and / or Owner.

3.06 REPAIR OF METAL PANELS & SIDING

A. Damaged or rusting panels/siding shall be patched with sheet metal and caulked as required, or as detailed on the drawings. Dented panels/siding or panels/siding with small penetrations (less than 5/8" diameter) shall receive filler. Prepare substrate and apply filler according to manufacturer's instructions to adhere to surface and achieve a smooth, blended surface for receiving paint.

B. Panels damaged by construction operations that cannot be repaired to satisfaction of the Architect shall be replaced.

END OF SECTION 07 42 13

SECTION 07 52 16 - SBS MODIFIED BITUMEN MEMBRANE ROOFING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Preparation of Substrate to Receive Roofing Materials.
   2. Roof Insulation Application to Prepared Substrate.
   3. Roof Membrane Application.
   4. Incorporation of Sheet metal Flashing Components and Roofing Accessories into the Roof System

B. Products installed but not furnished under this section
   1. Sheet Metal Flashing and Trim.
   2. Sheet Metal Roofing Specialties.

C. Related Sections
   1. Division 05 Section - Steel Decks.
   2. Division 06 Section - Rough Carpentry, for wood blocking.
   3. Division 07 Section - Sheet Metal Flashing and Trim.
   4. Division 07 Section - Metal Wall Panels, for coordination of details between roofing and metal panels at back side of parapets.
   5. Division 07 Section - Roof Accessories.
   6. Division 07 Section - Roof Specialties.
   7. Division 22 Section - Storm Drainage Piping Specialties, for roof drains.

1.03 REFERENCE STANDARDS

A. References in these specifications to standards, test methods and codes, are implied to mean the latest edition of each such standard adopted. The following is an abbreviated list of associations, institutions, and societies which may be used as references throughout these specifications.
   1. ASTM - American Society for Testing and Materials, Philadelphia, PA.
   2. FM - Factory Mutual Engineering and Research, Norwood, MA.
   3. NRCA - National Roofing Contractors Association, Rosemont, IL.
   4. OSHA - Occupational Safety and Health Administration, Washington, DC.
   5. SMACNA - Sheet Metal and Air Conditioning Contractors National Association, Chantilly, VA
   6. UL - Underwriters Laboratories, Northbook. IL

1.04 DESCRIPTION OF WORK

A. The basic work description required in this specification are referenced below:
   1. Roofing Type: Two ply SBS modified bitumen roof system. Johns Manville Specification 2FID or equal by approved manufacturer.
   2. Deck: Metal deck as indicated on drawings
   3. Slope: 1/4 inch.
   4. Insulation - Bottom Layer: Polyisocyanurate, at thickness as indicated on drawings, and in section 07 21 00 Thermal Insulation, mechanically attached.

5. Insulation - Top Layer: High density fiberboard or perlite board, having a thickness of 3/4", applied in hot asphalt.
6. Roof System Membranes:
   a. Base Sheet: ASTM D-6163, Type I, Grade S., applied in ASTM D-312 Type IV asphalt. Johns Manville Dynabase or comparable product by other approved manufacturer.
   b. Highly Reflective Cap Sheet: ASTM D-6163, Type I, Grade G, applied in D-312 Type IV asphalt. Johns Manville DynaGlas FR CR, or comparable product by other approved manufacturer.
7. Flashing System Membrane:
   a. Hot mop applied, ASTM D-6163, Type I, Grade G. Highly reflective SBS cap sheet to match the field membrane. Mechanically fastened base sheet per Manufacturer's recommendations where required. Johns Manville DynaWeld Cap FR CR, or comparable product by other approved manufacturer.
   b. Where required for roof warranty, use liquid applied membrane flashing at roof penetrations and any existing openings with less than 8" vertical rise above the new roofing surface.
   c. Roofing manufacturer's approved, non-reflective, base flashing system at repair to existing locations as required for roof warranty.

1.05 PERFORMANCE REQUIREMENTS

A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.

B. Testing Requirements: The roof system shall be tested in compliance with local code requirements and as follows:
   1. Wind Resistance: The roof system shall be tested in compliance with FM4474, and with UL 580 or UL 1897, and shall be Class 1-90.
   2. Physical Weathering Properties: The system shall be tested to demonstrate physical integrity over the working life of the roof based upon 2,000 hours of exposure to accelerated weathering tests conducted in accordance with ASTM G152, ASTM G154, or ASTM G155.
   3. Impact Resistance: The system shall be tested to resist impact damage based on the results of tests conducted in accordance with ASTM D3746, ASTM D4272, CGSB 37-GP-52M, or the "Resistance to Foot Traffic Test" in Section 5.5 of FM 4470. Hail resistance rating - SH.
   4. Fire Classification: The system shall be identified and listed for the fire class as required by local code by an approved testing agency, tested in compliance with ASTM E 108 or UL 790.

C. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

D. Energy Performance: Provide roofing system with initial Solar Reflectance Index (SRI) not less than 83, and 3-year aged SRI not less than 65, when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency.

E. Jobsite Safety: Execute all operations and provide a safe work environment in accordance with OSHA standards and regulations.
   1. Follow all industry, code, fire prevention guidelines and requirements for storage of materials, staging areas, roof access, and application means and methods.

1.06 SUBMITTALS

A. Product data: for each type product indicated.
   1. For products from other than the basis of design manufacturer, submit complete comparison of properties to the basis of design products.

B. Shop Drawings: For roofing system. Include plans, elevations, sections, details and attachments to other Work, including but not necessarily limited to the following:
   1. Base flashings, cants, copings, edge flashings, penetration flashings, and other membrane terminations.
   2. Plan showing all locations to receive tapered insulation, including slopes. Tapered insulation shown in Drawings is diagrammatic. All tapered insulation required to prevent ponding as defined by the roofing Manufacturer's warranty requirements is a part of the base scope of this contract. Include crickets at all mechanical curbs and similar obstructions to water flow, whether or not such crickets are specifically indicated in the Drawings.
   3. Insulation fastening patterns.

C. Samples for Verification:
   1. Manufacturer’s standard sample size roofing membranes and cap sheet
   2. Manufacturer’s standard sample size cover board
   3. Manufacturer’s standard sample size of roof insulation
   4. Manufacturer’s standard sample size walkway / protection pad

D. Submit certification that materials meet ASTM, federal, local code, and performance specifications, and that materials furnished are compatible for deck indicated each one to the other and to adjacent related work. Certificates shall be from the material manufacturer. Certificates from suppliers or wholesalers will not be acceptable.

E. Submit Test Reports indicating that roof materials comply with minimum solar reflectance index requirements noted in performance requirements.

F. Submit sample form of special warranty as specified in this Section.

1.07 CLOSEOUT SUBMITTALS

A. This documentation is a prerequisite for final acceptance.
   1. Signed and fully actuated warranties.
   2. Manufacturer’s printed recommendations for proper maintenance of the specified roof system including inspection frequencies, penetration addition policies, temporary repairs and leak call procedures.
   3. Installer's Guarantee contact information and leak call procedures.
   4. Submit site visit reports from Manufacturer’s representative.
   5. Include all changes to plans, details, and specifications, as well as all RFI’s, ASI’s, and Change Orders related to roofing in project Record Documents (Record Drawings and O & M’s).

1.08 QUALITY ASSURANCE

A. Acceptable Products: Primary roofing products, including each type of sheet, all manufactured in the United States, shall be supplied by a single manufacturer which has been successfully producing the specified types of primary products for not less than 10 years. The primary roofing products shall have maintained a consistent composition for a minimum of five years.

B. Product Quality Assurance Program: Primary roofing materials shall be manufactured under a quality management system that is monitored regularly by a third party auditor under the ISO 9001:2000 or equivalent audit process.

C. Agency Approvals: The proposed roof system shall conform to the following requirements. No other testing agency approvals will be accepted.
   1. Underwriter Laboratories Class A acceptance of the proposed roofing system (including mopping asphalt or cold adhesive) without additional requirements for gravel or coatings.

D. Acceptable Contractor: Contractor shall have a minimum of 5 years experience in successfully installing the same or similar roofing materials and be certified in writing by the roofing materials manufacturer to install the primary roofing products.

E. Scope of Work: The work to be performed under this specification shall include but is not limited to the following: Attend necessary job meetings and furnish competent and full time supervision, experienced roof mechanics, all materials, tools and equipment necessary to complete, in an acceptable manner, the roof installation in accordance with this specification. Comply with the latest written application instructions of the manufacturer of the primary roofing products. In addition, application practice shall comply with requirements and recommendations contained in the latest edition of the Handbook of Accepted Roofing Knowledge (HARK) as published by the National Roofing Contractor's Association, amended to include the acceptance of a phased roof system installation.

F. Local Regulations: Conform to regulations of public agencies, including any specific requirements of the city and/or state of jurisdiction.

G. Manufacturer Requirements: Ensure that the primary roofing materials manufacturer provides direct trained company personnel to attend necessary job meetings, perform periodic inspections as necessary, and conducts a final inspection upon successful completion of the project.

H. Testing and Verification:
   1. Owner retains the right, at Owner's option, to sample all roofing products on site for testing by an accredited laboratory without advance notice or additional cost to Owner to patch test samples.
   2. Owner may, at Owner's option, select and employ at Owner's expense:
      a. A roofing systems Consultant to review the Construction Documents and/or perform surveillance during any installation of substrate, roofing, flashing and any other part of the total roofing system.
      b. An independent roofing inspection service specializing in performing Non Destructive Evaluation (NDE), for moisture detection purposes, before the final acceptance of the roofing or before the end of the roofing Guarantee Period.
   3. Prior to final acceptance, Contractor shall water test all roof drains. Architect and Program Manager shall be notified prior to conducting water tests.
   4. A representative of Owner, the Program Manager, the General Contractor, the Roofing Contractor and Roofing Manufacturer's technical representative shall review the roofing system toward the end of the warranty period and toward the end of the Roofing Contractor's guarantee period. The Roofing System Manufacturer's authorized technical representative shall inspect the roofing system near the close of the Manufacturer's warranty. The Roof System Manufacturer's representative within seven days of each site visit shall submit a written report to Owner.

I. The roofing system product supplier shall furnish the Roofing Contractor with Material Safety Data Sheet/Sheets (MSDS), incorporating OHSA approved form, current edition. Said sheets shall be available at the site at all times until project completion. A copy shall be included in the project closeout documentation.

J. Pre-Installation Meetings:
   a. Tour, inspect, and discuss existing conditions.

b. Review project specifications and their requirements. Review special flashing and installation details.
c. Review manufacturer's inspection requirements and forms.
d. Review required submittals, both completed and yet to be completed.
e. Review coordination of roof penetrations.
f. Review required inspections, testing, certifying, and material usage accounting procedures.
g. Review temporary protection requirements.
h. Manufacturer's requirements for priming surfaces at embedded metal to directly receive roof flashing.
    1) Provide copy of manufacturer's written approvals of roofing materials.
i. Review checklist items, including but not limited to:
    1) Base flashings shall extend a minimum 8" height from finished membrane. Verify curb heights for all new equipment have been coordinated.
    2) Counter flashings on A/C, ventilators, and other roof top equipment shall have soldered corners, and curb size shall be coordinated with equipment submittals.
    3) Thru-wall scuppers and escutcheon plates shall be soldered and sealed entirely at face of building. Discuss leader box overflow requirements.
    4) Pipe support requirements.
    5) All equipment and supports resting on roof membrane require roof pads.
    6) All trades to provide protection board at their work areas, and storage on roof when works occurring after roofing operations are complete cannot be avoided. All trades required to keep their work area clean and roof surface clear of their screws and other potentially damaging hardware, equipment, and debris.
    7) Metal workers and base flashings shall not damage completed roof membranes.
    8) No penetrations through base flashings. No penetrations through top side of roof curb flashing caps.
    9) Sealant filled hooded pans required at all small pipe penetrations.
    10) Refrigerant line penetrations (peel back insulation first, then seal, then replace insulation).
    11) Cutting oils, refrigerant oils, soldering, etc. above roof will cause concern. Discuss plans to address concerns and protect roofing.
    12) Keep through-wall flashings below weep vents where roofing abuts brick veneer walls.
    13) Where roofing extends to bottom of windows in walls above adjacent roofing, solder and seal any flashing joints. No exposed fasteners or penetrations in sill flashings or counter flashings.
    14) Overflow drains shall be 2" above primary roof drain elevation, unless noted otherwise.
    15) Ponding water 48-hrs after rain event shall be evidence of improper slope. Contractor shall provide tapered insulation and install membrane laps in manner to prevent ponding.
    16) Dirt legs at gas lines shall have 1" minimum clearance from finished roof membrane.
    17) Plumbing stack lead flashings shall turn inside a minimum 1" distance.
    18) Provide splash blocks or pans where one roof drains to another roof surface.
    19) Exposed wood blocks shall not be permitted on top of roofing membrane unless specifically indicated in Drawings.
    20) All roof penetrations shall be a minimum 2'-0" (or other distance as required by Contract Documents, or as required by roofing Manufacturer) away from other roof penetrations, from roof edges, or from parapet walls, whichever distance is greatest in each case.

21) Supports for roof ladders must not penetrate base flashings or copings. For back side of parapet walls not otherwise detailed in Drawings, install metal roof panel with treated blocking behind panel (to prevent crushing of wall panel); lag bolt ladder through metal panel to blocking inside of wall. Seal & gasket fastener penetrations.
22) Clamping rings at drains shall be tightened after installation.
23) Adhere to Manufacturers' recommendations for fastener spacing.
24) Avoid stepping of through-wall flashings and base flashings to maximum extent possible.
25) Provide lining at pipe support clamps to prevent corrosion between dissimilar metals.
26) All exposed gas piping to be painted per painting specifications.
27) Rise wall flashings must not cover weeps at any exterior finish materials.
28) Screws through decking shall not be visible at exposed deck at either the interior of the building or at exterior canopies.
29) Electrical wiring shall be installed within equipment curbs and other construction to maximum extent possible. Where penetrations are unavoidable, provide liquid scrim flashing system on 12" vertical hard pipe with gooseneck, for threaded UV resistant flex conduit attachment.
30) Condensate shall be installed within equipment curbs where possible, unless otherwise indicated. Where copper condensate is shown to be used above roof, paint it to match gas piping.
31) Coordination of lightning protection penetrations and attachment details with roof warranty requirements.
32) Final roof inspections will include acceptance from the manufacturer, the General Contractor, the roofing contractor / installer, the Architect, and Owner, prior to final payment.

K. Roofing Conferences: Allow for two additional roofing conferences to be called for as deemed necessary by the Architect; one being a conference for final inspection & project wrap-up.

1.09 PRODUCT DELIVERY STORAGE AND HANDLING

A. Delivery: Deliver materials in the manufacturer’s original sealed and labeled containers and in quantities required to allow continuity of application.
   1. Deliver in packaging, or with certificate or bill of materials, bearing approved testing agency labels as required by code and authorities having jurisdiction.

B. Storage: Store materials out of direct exposure to the elements. Store roll goods on a clean, flat and dry surface. All material stored on the roof overnight shall be stored on pallets. Rolls of roofing must be stored on ends. Store materials on the roof in a manner so as to preclude overloading of deck and building structure. Store materials such as solvents, adhesives, and asphalt cutback products away from open flames, spark, or excessive heat. Cover all material using a breathable cover such as a canvas. Polyethylene or other non-breathable plastic coverings are not acceptable.

C. Handling: Handle all materials in such a manner as to preclude damage and contamination with moisture or foreign matter. Handle rolled goods to prevent damage to edges or ends. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

D. Damaged Material: Any materials that are found to be damaged or stored in any manner other than stated above will be automatically rejected, removed and replaced at the Contractor’s expense.

1.10 PROJECT/SITE CONDITIONS

A. Requirements Prior to Job Start
   1. Notification: Give a minimum of 5 days notice to the Testing Lab and Manufacturer prior to commencing any work, and notify both parties on a daily basis of any change in work schedule.
   2. Permits: Obtain all permits required by local agencies and pay all fees which may be required for the performance of the work.
   3. Coordinate with other trades for all roofing preparation requirements, including but not limited to items listed in pre-installation meeting requirements and agenda.
   4. Coordinate all requirements for Manufacturer's full warranty of the roofing system, without exclusions. Should conflicts be discovered between Manufacturer's requirements and requirements of the Drawings and Specifications, generally the most restrictive requirement shall prevail. Notify Architect immediately upon discovery of conflicts. Contractor shall not be due additional compensation for correction of conditions required for roof warranty due to his failure to coordinate Manufacturer's requirements.

B. Environmental Requirements
   1. Precipitation: Do not apply roofing materials during precipitation or in the event there is a probability of precipitation during application. Take adequate precautions to ensure that materials, applied roofing, and building interiors are protected from possible moisture damage or contamination.
   2. Temperature Restrictions - asphalt: At ambient temperatures of 40° F and below, special precautions must be taken to ensure that the specified Type IV asphalt maintains a minimum acceptable 400°F at the point of sheet application. The asphalt must not be overheated to compensate for cold conditions. The use of insulated handling equipment is strongly recommended. Hot luggers, mop carts, and kettle-to-roof supply lines should be insulated. Hand mops should be constructed with a smaller yarn head to facilitate short moppings. Luggers and mop carts should never be more than half filled at all times.

C. Protection Requirements
   1. Membrane Protection: Provide protection against staining and mechanical damage for newly applied roofing and adjacent surfaces throughout this project.
   2. Torch and Hot Work Safety (for work over Owner-occupied facilities): Designate one person on each crew to perform a daily fire watch. The designated crew member shall watch for fires or smoldering materials on all areas of roof construction. Continue the fire watch after roofing material application has been suspended for the day.
   3. Limited Access (for Partially-Occupied Sites): Erect temporary fencing or other barriers as required to prevent access by the public or Owner's personnel to areas where potentially hazardous materials, tools and equipment are located during the course of the project.
   4. Debris Removal: Remove all debris daily from the project site and take to a legal dumping area authorized to receive such materials.
   5. Site Condition: Complete, to the owner’s satisfaction, all job site clean-up including building interior, exterior, and landscaping where affected by the construction.

1.11 WARRANTY / GUARANTEE

A. Special Warranty: Manufacturer's standard or customized form, non-pro-rated and without monetary limitation, in which manufacturer agrees to 100% repair or replacement of components of membrane roofing system that fail in materials or workmanship within specified warranty period.
   1. Special warranty includes membrane roofing, base flashings, roof insulation, fasteners, cover boards, substrate board, roofing accessories, roof penetrations flashed with liquid flashing system, and any other components of membrane roofing system.
   2. Warranty Period: 20 years from date of Substantial Completion.

B. Installer's Guarantee: Submit roofing Installer's guarantee, signed by Installer, covering the Work of this Section, including all components of membrane roofing system as required to maintain roof in water tight condition for the duration of the warranty period. Guarantee shall cover roofer's complete scope of work including metal flashings and copings:
   1. Guarantee Period: Five years from date of Substantial Completion.

C. A fully executed Warranty and Guarantee, delivered to the Owner or included in project record documents in triplicate, and accepted by Owner, is a prerequisite for final Acceptance of the project by Owner.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Product: The design for modified bitumen roofing is based on Johns Manville. Subject to compliance with requirements, provide the named products or comparable products by one of the following:
   1. Derbigum.
   2. GAF Materials Corporation.
   3. Siplast, Inc.
   4. Soprema.
   5. Other approved equal. Substitutions must be approved by Architect. See Division 1 specifications for requirements for proposed substitutions. Substitutions for convenience will only be considered within first 30 days after notice to proceed.

2.02 ROOFING SYSTEM ASSEMBLY / PRODUCTS

A. Rigid Roof Insulation shall be UL and FM approved. Insulation shall be approved in writing by the insulation manufacturer for intended use and for use with the specified roof assembly. Maintain a minimum panel size of 4 feet by 4 feet where insulation is specified to be installed in hot asphalt.
   1. Polyisocyanurate: A closed cell, rigid polyisocyanurate foam core material, integrally laminated between glass fiber facers, in full compliance with ASTM C1289, Type II, Class 1, Grade 1. Panels shall have a nominal thickness of two staggered layers of 2.2" to achieve an Long Term aged Thermal Resistance R25.5 value per ASTM C1289-13e1. Acceptable types are as follows:
      a. ENRGY 3 by Johns Manville, Inc.; Denver, CO.
      b. ACFoam II by Atlas Energy Products; Atlanta, GA
      c. Paratherm by Siplast/Icopal; Irving, TX.
      d. Multi-Max FA by RMAX, Inc.; Dallas, TX.
      e. H-Shield by Hunter Panels, LLC; Portland, ME.
   2. Polyisocyanurate Tapered Roof Insulation: Tapered panels and standard fill panels composed of a closed cell, rigid polyisocyanurate foam core material, integrally laminated between glass fiber facers. In full compliance with ASTM C 1289, Type II,

Class 1, Grade 1. The tapered system shall provide for a roof slope of 1/4 inch per foot and together with un-tapered insulation layer(s) below, shall have a minimum thickness sufficient to achieve an aged thermal resistance as specified for rigid insulation above. Acceptable types are as follows:

a. Tapered ENRGY 3 by Johns Manville, Inc.; Denver, CO.
b. Tapered Paratherm by Siplast/Icopal; Irving, TX.
c. ACFoam II Tapered Insulation Systems by Atlas Energy Products; Atlanta, GA.
d. Tapered H-Shield by Hunter Panels, LLC; Portland, ME.
e. Tapered Thermaroof by RMAX, Inc.; Dallas, TX.

3. Cover Board - Fiberboard: A high density panel composed of interlocking wood fibers and waterproofing binders, having a top surface that is pre-treated with an asphalt based coating. Fiberboard panels shall be in full compliance with ASTM C 208, Type II, Grade 2, and ASTM C 209 (water absorption - 7% volume maximum) requirements. Panels shall have a nominal thickness of 1/2 inch. Acceptable types are as follows:
   a. Johns Manville 3/4" Fesco Board.
   b. Siplast Wood Fiberboard by Siplast/Icopal; Irving, TX.
   c. High Density Fiberboard by the Celotex Corp.; Tampa, FL.
   d. Structodeck by Wood Fiber Industries; Chicago, IL.
   e. Fiber Base by Temple-Inland Forest Products Corporation; Diboli, TX.
   f. High Density Roof Insulation by Huebert Fiberboard, Inc.; Boonville, MO.
4. Cover Board - Perlite: As an alternate and when required by the primary roofing manufacturer for a single source warranty, perlite board meeting ASTM D-728. 3/4" thickness.

2.03 DESCRIPTION OF SYSTEMS

A. Roofing Membrane Assembly: A roof membrane assembly consisting of two plies of a prefabricated, reinforced, homogenous Styrene-Butadiene-Styrene (SBS) block copolymer modified asphalt membrane, hot mop applied over a prepared substrate. Both reinforcement mats shall be impregnated/saturated and coated each side with an SBS modified bitumen blend. The roof system shall pass 500 cycles of ASTM D 5849 Resistance to Cyclic Joint Displacement (fatigue) at 14° F. Passing results shall show no signs of membrane cracking or interply delamination after 500 cycles. The roof system shall pass 200 cycles of ASTM D 5849 after heat conditioning performed in accordance with ASTM D 5147. The assembly shall possess waterproofing capability, such that a phased roof application, with only the modified bitumen base ply in place, can be achieved for prolonged periods of time without detriment to the watertight integrity of the entire roof system. Roof system to match roof system installed at Career Development Center.

1. Modified Bitumen Base and Stripping Ply: ASTM D 6163, Grade S, Type I, SBS-modified asphalt sheet, smooth surfaced; suitable for application method specified.
   a. Siplast: Paradiene 20.
      1) ASTM D-6163, Type I, Grade S.
      2) Thickness (avg.): 90 mils (ASTM D 5147).
      3) Weight (min per 100 sq. ft of coverage): 60 lb.
      4) Low temperature flexibility @ -10° F: PASS (ASTM D 5147).
      5) Dimensional Stability (max): 0.2% (ASTM D 5147).
      6) Approvals: UL Class listed, FM Approved (products shall bear seals of approval).
      7) Reinforcement: Fiberglass scrim/fiberglass mat or other meeting the performance and dimensional stability criteria.
2. Modified Bitumen Finish Ply: ASTM D6163, Grade G, Type I, SBS-modified asphalt sheet, high SRI granular surfaced; suitable for application method specified.
   a. Siplast: Paradiene 30 FR

1) ASTM D-6163, Type I, Grade G.
2) Thickness (avg.): Minimum of 130 mils (ASTM D 5147).
3) Weight (min per 100 ft square of coverage). 90 lb.
4) Dimensional Stability (max): 0.2% (ASTM D 5147).
5) Approvals: UL Class listed, FM Approved (products shall bear seals of approval).
6) Reinforcement: Fiberglass mat or other meeting the performance and dimensional stability criteria.
7) Surfacing: Ceramic or synthetic granules meeting minimum solar reflectance index requirements of 83 initial, 65 3-year aged.

B. Flashing Membrane Assembly: A flashing membrane assembly consisting of a prefabricated, reinforced, Styrene-Butadiene-Styrene (SBS) block copolymer modified asphalt membrane with a continuous granule surfacing. The finish ply shall conform to the following physical and mechanical property requirements:
   1. Flashing Reinforcing Ply (Same as roof system base ply)
   2. Siplast: Parapro 123 Flashing System.
      a. ASTM D-6163, Type I, Grade G.
      b. Approvals: UL Approved, FM Approved (products shall bear seals of approval).
      c. Reinforcement: Fiberglass scrim mat or other meeting the performance and dimensional stability criteria.
      d. Surfacing: Ceramic or synthetic granules meeting minimum solar reflectance index requirement of 83 initial, 65 3-year aged.

C. Liquid-Applied Membrane Flashing: A flashing membrane assembly approved by the Roofing Manufacturer for the conditions indicated to achieve warranty as specified, consisting of a reinforcing scrim or fabric, encapsulated in resinous or elastomeric liquid applied flashing material. UV resistant and suitable for intended substrate(s).
   1. Siplast Parapro 123 Flashing System, or Roofing Manufacturer's approved equal product.
   2. Where used: Roof Penetrations, and other locations as required by Manufacturer for specified warranty on the full roof system.

2.04 ROOFING ACCESSORIES

A. Roofing Manufacturer's Approval
   1. Roofing accessories and miscellaneous materials shall be approved in writing by roofing Manufacturer for use as part of the roofing assembly for this project, prior to installation.

B. Roofing Adhesives
   1. Mopping Asphalt: Type IV asphalt certified for full compliance with the requirements listed in Table I, ASTM D 312. Each container of bulk shipping ticket shall indicate the equiviscous temperature, EVT, the finished blowing temperature, FBT, and the flash point, FP. Mopping asphalt shall be approved in writing by the roof membrane manufacturer.
      a. Trumbull ASTM D-312, Type IV, or as approved by the primary roofing manufacturer.
   2. Insulation Adhesive: At existing lightweight concrete deck, Manufacturer's recommended insulation adhesive to achieve required uplift resistance and for adhering insulation to substrate and conditions uncovered by roof tear-off.

C. Bituminous Cutback Materials
   1. Primer: A high flash, quick drying, asphalt solvent blend which meets or exceeds ASTM D 41 requirements, as provided by the primary roofing manufacturer.

2. Mastics: An asphalt cutback mastic, reinforced with non-asbestos fibers, used as a base for setting metal flanges conforming to ASTM D 4586 Type II requirements, as provided by the primary roofing manufacturer.

D. Sealant: A moisture curing, non-slump elastomeric sealant designed for roofing applications. The sealant shall be approved by the roof membrane manufacturer for use in conjunction with the roof membrane materials.

E. Asphalt Bleed-out Masking:
   1. Roofing Granules: Ceramic or synthetic granules of color scheme matching the granule surfacing of the finish ply, meeting minimum SRI index specified.
   2. Use of coating as provided by primary roofing manufacturer, meeting minimum SRI index specified, requires specific approval by Architect. Coating is not an acceptable solution to repair roof membrane soiled by construction activities, unless specifically approved by Architect. Architect reserves right to reject a coating as equal installation to granules in any and all cases.

F. Perlite Cant Strips: A cant strip composed of expanded volcanic minerals combined with waterproofing binders. The top surface shall be pre-treated with an asphalt base coating. The face of the cant shall have a nominal 4 inch dimension.

G. Expansion Joints: Provide factory fabricated weatherproof exterior covers for expansion joint openings as detailed in the Drawings and as required by roofing Manufacturer for complete installation.

H. Fasteners
   1. Insulation Fasteners: Insulation fasteners and plates shall be FM Approved, and/or approved by the manufacturer of the primary roofing products. The insulation fasteners shall provide attachment required to meet the specified uplift performance and to restrain the insulation panels against the potential for ridging. The fastening pattern for each insulation panel to be used shall be as recommended by the insulation manufacturer and approved by the manufacturer of the primary roofing products. Acceptable insulation fastener manufacturers for specific deck types are listed below.
      a. Base Sheet Fasteners for Lightweight Concrete Decks: Twin-legged expanding base sheet fasteners. Manufactured from G-90 galvanized steel and coated with a fluoropolymer coating which meets the Factory Mutual Approval Standard #4470. Leg length shall be 1.7" for lightweight concrete decks and 1.2" for gypsum roof decks. Integral disc is a 2 3/4" diameter Galvalume® plate. Johns Manville LWC CR Base Ply Fasteners or comparable product by other approved manufacturer.
      b. Metal Decks: Insulation mechanical fasteners for metal decks shall be factory coated for corrosion resistance. The fasteners shall meet or exceed Factory Mutual Standard FMG 4470, and when subjected to 30 Kesternich cycles, show less than 15% red rust. Designed for fastening roof insulation to substrate, and provided or approved by primary roofing system Manufacturer.
         1) A fluorocarbon coated screw type roofing fastener having a minimum 0.220 inch thread diameter. Plates used in conjunction with the fastener shall be a metal type having a minimum 3 inch diameter as supplied by the fastener manufacturer.
            a) As provided or approved by the primary roofing Manufacturer.

I. Walktread: A prefabricated, puncture resistant polyester core reinforced, polymer modified bitumen sheet material topped with a ceramic-coated or synthetic granule wearing surface as provided by the primary roofing Manufacturer. Johns Manville DynaTred Plus or comparable product by other approved manufacturer.
   1. Where available from roofing Manufacturer, use product matching cap sheet finish or with SRI 83 or greater.

PART 3 - EXECUTION

3.01 EXAMINATION AND PREPARATION

A. General: Sweep or vacuum all surfaces, removing all loose aggregate and foreign substances and sharp projections detrimental to roofing installation, according to roofing manufacturer's written instructions and prior to commencement of roofing.

B. Examine substrates, areas and conditions with installer present to verify roof openings and penetrations are in place, roof drains are secured in place, blocking, curbs and nailers are properly installed, and verify deck substrates are ready to receive installation. Proceed only when installation conditions are satisfactory per manufacturer's recommendations.
   1. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
      a. Test for moisture by pouring 1 pint hot roofing asphalt on deck at start of each day's work and start of each roof plane. Do not proceed with roofing work if test sample foams or can be easily and cleanly stripped after cooling.

3.02 SUBSTRATE PREPARATION

A. Insulation: Install insulation panels with end joints offset; edges of the panels shall be in moderate contact without forcing applied, in strict accordance with the insulation manufacturer's requirements and the following instructions. Where insulation is installed in two or more layers, stagger joints between layers. Maintain a maximum panel size of 4 feet by 4 feet for insulation applied in hot asphalt.
   1. Insulation - double or multiple layers: Provide fasteners as required for wind resistance rating, and not less than the following, whichever is greater:
      a. At Metal Deck, mechanically attach the bottom layer, using the specified fasteners, at a rate of 1 fastener per 2 square feet of panel area (16 per 4' x 8' panel). Increase the fastening frequency by 50% (but not less than one fastener per two square feet) at the perimeter of the roof area and by 100% (but not less than one fastener per one square foot) at the corners.
   2. Insulation - tapered insulation with cover board: Install all layers in a solid mopping of hot asphalt. Stagger the panel joints between insulation layers.

3.03 ROOF MEMBRANE INSTALLATION

A. Membrane Application: Apply roofing in accordance with roofing system manufacturer's instructions and the following requirements. Base sheet shall be inspected by roofing Manufacturer's representative and Dallas ISD's roofing specialist or roofing consultant, prior to application of cap sheet. Schedule required inspections prior to beginning roofing Work.
   1. Take precautions to prevent materials from entering or clogging roof drains, scuppers, pipes, or other similar devices. Remove roof drain and scupper plugs or covers when no work is taking place or when rain is forecast.

B. Aesthetic Considerations and Patching: An aesthetically pleasing overall appearance of the finished roof application is a standard requirement for this project. Make necessary preparations, utilize recommended application techniques, apply the specified materials including granules and exercise care in ensuring that the finished application is acceptable to the Owner.
   1. Finished application should contain no wrinkles, creases, fishmouths, sagging of base flashings, or other visible imperfections.
   2. Bleed-out of asphalt fully masked to consistent appearance and conforming with SRI requirements.
   3. Excessive patching in new roof areas will require removal and replacement if, in the opinion of the Architect, aesthetic quality is compromised.

4. Excessive patching in new roof areas will require removal and replacement if, in the opinion of the Manufacturer's representative, the amount of patching is to the extent that it is no longer qualified as a new roof or would affect roof warranty.

C. Priming: Prime metal and concrete and masonry surfaces with a uniform coating of the specified asphalt primer.

D. Kettles and Tankers: Kettles and tankers shall be equipped with accurate, fully readable thermometers. Do not heat asphalt to, or above, its flash point. Avoid heating at, or above, the FBT. Should conditions make this impractical, heating must be no more than 25° F below the EVT, and no more than 25° F above EVT. Contractor shall monitor and maintain a record available for review if required by Owner or Manufacturer's representative.

E. Asphalt Temperatures: If the EVT information is not provided, the following asphalt temperature shall be observed. Maximum heating temperature shall be 525° F. Minimum application temperature shall be 450° F.

F. Asphalt Moppings: Ensure that all moppings do not exceed a maximum of 25 lb/sq. Mopping shall be total in coverage, leaving no breaks or voids.

G. Bitumen Consistency: Cutting or alterations of bitumen, primer, and sealants will not be permitted.

H. Roofing Application: Apply all layers of roofing free of wrinkles, creases or fishmouths. Exert sufficient pressure on the roll during application to ensure prevention of air pockets.
   1. Apply all layers of roofing perpendicular to the slope of the deck.
   2. Fully bond the base ply to the prepared substrate, utilizing minimum 3 inch side laps and minimum 12 inch end laps. Apply each sheet directly behind the asphalt applicator. Cut a dog ear angle at the end laps on overlapping selvage edges. Using a clean trowel, apply top pressure to top seal T-laps immediately following sheet application. Stagger end laps a minimum of 3 feet.
   3. Fully bond the finish ply to the base ply, utilizing minimum 3 inch side and end laps. Apply each sheet directly behind the asphalt or torch applicator. Stagger end laps of the finish ply a minimum 3 feet. Cut a dog ear angle at the end laps on overlapping selvage edges. Using a clean trowel, apply top pressure to top seal T-laps immediately following sheet application. Stagger side laps of the finish ply a minimum 12 inches from side laps in the underlying base ply. Stagger end laps of the finish ply a minimum 3 feet from end laps on the underlying base ply.
   4. Maximum sheet lengths and special fastening of the specified roof membrane system may be required at various slope increments where the roof deck slope exceeds 1/2 inch per foot. The manufacturer shall provide acceptable sheet lengths and the required fastening schedule for all roofing sheet applications to applicable roof slopes.

I. Granule Embedment: Broadcast granules over all bitumen overruns on the finish ply surface, while the bitumen is still hot or the adhesive is soft, to ensure a monolithic surface color, compliant with SRI index requirements.

J. Flashing Application - Masonry Surfaces: Flash masonry parapet walls and curbs using the reinforcing sheet and the flashing membrane. After the base ply has been applied to the top of the cant, fully adhere the reinforcing sheet, utilizing minimum 3 inch side laps and extend a minimum of 3 inches onto the base ply surface and 3 inches up the parapet wall above the cant. After the final roofing ply has been applied to the top of the cant, prepare the surface area that is to receive flashing coverage by by application of asphalt primer; allowing primer to dry thoroughly. Hot mop apply the flashing membrane into place using three foot widths (cut off the end of roll) always lapping the factory selvage edge. Stagger the laps of the flashing layer from lap seams in the reinforcing layer. Extend the flashing sheet a minimum of 4 inches beyond the toe of the cant onto the prepared surface of the finished roof and up

the wall to the desired flashing height. Exert pressure on the flashing sheet during application to ensure complete contact with the wall/roof surfaces, preventing air pockets. Check and seal all lose laps and edges. Nail the top edge of the flashing on 9 inch centers. Mechanically fasten membranes at parapets walls as recommended by roofing Manufacturer.

K. Flashing Application - Wood Surfaces: Flash wood or plywood parapet walls and curbs using the reinforcing sheet and the flashing membrane. The reinforcing sheet shall have minimum 3 inch side laps and extend a minimum of 3 inches onto the base ply surface and to the top of the parapet wall or curb. Nail the reinforcing sheet through the field of the sheet to the vertical wood surface on 12 inch centers from the top of the cant to top of the wall or curb. Fully adhere the remainder of the flashing reinforcing sheet that extends over the cant and roof level. After the final roofing ply has been applied to the top of the cant, prepare the surface area that is to receive flashing coverage by application of asphalt primer; allowing primer to dry thoroughly. Hot mop apply the flashing into place using three foot widths (cut off the end of roll) always lapping the factory selvage edge. Extend the flashing sheet a minimum of 4 inches beyond the toe of the cant onto the prepared surface of the finished roof and up the wall to the desired flashing height. Exert pressure on the flashing sheet during application to ensure complete contact with the wall/roof surfaces, preventing air pockets. Check and seal all loose laps and edges. Nail the top edge of the flashing on 9 inch centers. Mechanically fasten membranes at parapets walls as recommended by roofing Manufacturer.

L. Water Cut-Off: At end of day's work, or when precipitation is imminent, construct a water cutoff at all open edges. Cut-offs can be built using asphalt or plastic cement and roofing felts, constructed to withstand protracted periods of service. Cut-offs must be completely removed prior to the resumption of roofing.

3.04 ROOF SYSTEM INTERFACE WITH RELATED COMPONENTS

A. Edge Metal: Completely prime metal flanges and allow to dry prior to installation. Turn the base ply down 2 inches past the roof edge and over the nailer. After the base ply and continuous cleat (if applicable) have been installed, set the flange in mastic and stagger nail every 3 inches on center. Strip-in the flange using the stripping-ply material, extending a minimum of 4 inches beyond the edge of the flange. Terminate the finish ply at the gravel-stop rise of the edge metal. See item: Sealant, for finish of this detail.

B. Lead Pipe Flashings: Completely prime the lead flanges and allow to dry prior to installation. After the base ply has been applied, set the flange in mastic and strip-in the flange using the stripping-ply material, extending a minimum of 4 inches beyond the edge of the flange. Terminate the finish ply at the flange-sleeve juncture of the pipe flashing. See item: Sealant, for finish of this detail.

C. Lead Drain Flashings: Completely prime the lead drain flashing and allow to dry prior to installation. After the base ply has been applied, set the lead flashing sheet in mastic and form to turn down inside of the drain bowl. Ply-in the perimeter of the lead flashing using an additional layer of the base ply material, overlapping the perimeter of the lead a minimum of 4 inches. Terminate the finish ply to extend beneath the clamping ring seal. Install the clamping ring with all bolts in place.

D. Light Air Unit Supports: Where existing light air handing units or other equipment that are supported by wood sleepers (not supported by a roof curb) are to be removed and reinstalled, separate wood sleepers from the new roof assembly using the manufacturer's walktread-roof protection material. Cut each walktread pad to a size which extends a minimum of 2 inches beyond the perimeter of each sleeper block. Set the walktread pad dry over the new assembly. Set each sleeper block dry over the walktread pad.

E. Metal Pipe Flashings: Completely prime the metal pipe flanges and allow to dry prior to installation. After the base ply has been applied, set the flanges in mastic and strip-in the

flange using the stripping-ply material, extending a minimum of 4 inches beyond the edge of the flange. Terminate the finish ply at the flange-sleeve juncture of the pipe flashing. Install a watertight umbrella to the penetration, completely covering the opening of the pipe flashing. See Item: Sealant, for finish of this detail.

F. Walktreads: Cut the walktread into maximum 5 foot lengths and allow to relax until flat. Adhere the sheet in a full bed of Manufacturer's approved plastic cement. Walk-in each sheet after application to ensure proper adhesion. Use a minimum spacing of 2 inches between sheets to allow for proper drainage.
   1. Install walktreads in locations as shown on roof plan, at entry points to roof hatches, adjacent to roof ladders, around all rooftop HVAC units, and at service sides of other rooftop mechanical equipment.
   2. Install walktread material as sacrificial pads under pipe supports and other equipment supports that do not penetrate the roof as required by Manufacturer.
   3. Install all walktreads and pads so as not to cause water to pond.

G. Sealant: Apply a smooth continuous bead of the specified sealant at the exposed finish ply edge transition to metal flashings incorporated into the roof system.

3.05 FIELD QUALITY CONTROL AND INSPECTIONS

A. Site Conditions: Remove all screws, fasteners, and miscellaneous debris from completed roof. Leave all areas around job site free of debris, roofing materials, equipment, and related items after completion of job. Protect roofing system from damage and wear during the remainder of the construction period. Clean or repair any soiled roofing areas as required by Manufacturer for warranty requirements and to restore solar reflectance.

B. Notification Of Completion: Notify the manufacturer, by means of manufacturer's printed Notification of Completion form, of job completion in order to schedule a final inspection date.

C. Final Inspection
   1. Post-Installation Meeting: Hold a meeting at the completion of the project, attended by all parties that were present at the pre-job conference. A punch list of items required for completion shall be compiled by the Contractor and the manufacturer's representative. Complete, sign, and mail the punch list form to the manufacturer's headquarters. Provide one copy of the punchlist to the Architect.

D. Issuance of the Warranty: Complete all post-installation procedures and meet the Manufacturer's requirements for final endorsement for issuance of the specified warranty.

END OF SECTION 07 52 16

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Provide all metal flashing and sheet metal work, as shown on the drawings and as herein specified.

B. Related Sections include the following:
   1. Division 04 Section - Unit Masonry for through-wall flashing.
   2. Division 06 Section - Rough Carpentry for blocking, nailers, etc.
   3. Division 07 Section - Joint Sealers.
   4. Division 07 Section - Painting.
   5. Division 07 Section - Roofing for flashing membranes.
   6. Division 07 Section - Metal Roof Panels for sheet metal flashing and trim integral with metal roof panels.
   7. Division 07 Section - Metal Wall Panels for sheet metal flashing and trim integral with metal wall panels.
   8. Division 07 Section - Sheet Metal Roofing for custom-formed sheet metal flashing and trim integral with sheet metal roofing.
   9. Division 07 Section - Roof Specialties for manufactured roof specialties not part of sheet metal flashing and trim.
   10. Division 07 Section - Roof Accessories for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
   11. Division 07 Section - Expansion Control for manufactured sheet metal expansion-joint covers.

1.03 PERFORMANCE REQUIREMENTS AND QUALITY ASSURANCE

A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with the latest edition of NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
   1. Sheet Metal Standard for Copper: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

C. Fabricated copings and roof edge flashings: Roof edge flashings shall be designed without exposed fasteners, including at the inside face of copings, and as follows:
   1. Wind-Uplift Resistance: Provide metal roof edge flashing assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

2. SPRI Wind Design Standard: Fabricated copings and roof edge flashings for low slope roofs shall be designed and installed for wind loads in accordance with IBC Chapter 16, including local code amendments as applicable, and tested for resistance in accordance with Test Methods RE-1, RE-2 and RE-3 of ANSI/SPRI/FM 4435/ES-1.
    a. Roof edge products shall be UL Classified by Underwriters Laboratories, Inc. or other building code approved 3rd party verification of compliance with the ANSI/SPRI/FM 4435/ES-1 Wind Design Standard.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss. Account for temperature change of 120 deg F ambient, 180 deg F material surfaces.

E. Installer: Engage an experienced installer who has completed similar work of a comparable scale with a record of successful performance.

1.04 GUARANTEE

A. Sheet metal applicator and General Contractor shall personally guarantee sheet metal work for a period of Two-Years after acceptance of the building by the Owner against any defects or water leaks. Guarantee shall include all labor and materials necessary to correct any defects or water leaks upon notice from the Owner.

B. Furnish manufacturer's standard 20 year warranty stating architectural fluorocarbon finish will be:
    1. Free of fading of color change in excess of 6 NBS units as measured per ASTM D 2244-68;
    2. Will not chalk in excess of numerical rating of 7 when measured in accordance with standard procedures specified in ASTM D 659-74;
    3. Will not peel, crack, chip, or de-laminate.

1.05 SUBMITTALS

A. Division 01 Section - Submittal Procedures: Procedures for submittals.

B. Submit shop drawings for review and approval prior to ordering of materials and fabrication of the required shapes and metal flashings. Submittal for the coping system is required.

C. Failure by the contractor to submit shop drawings required above shall release the Architect from any liabilities due to the negligence on the part of the Contractor to comply with the construction documents.

D. Samples: Submit samples of sheet metal flashings, trim, copings, accessory items, and prefinished items of profiles, gauge and finish to be used.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Sheet metal for receivers and counter-flashings: 24 gauge or as noted on drawings galvanized sheet steel bent to required shapes.

B. Sheet metal for downspouts, leader boxes, scuppers, eave flashing, copings, gravel stops, gutters, drip edges and similar exposed items shall be 20 gauge hot-dip galvanized sheet steel. Bend to required shapes.

C. Stainless Steel Sheet: ASTM A 240 / A240M or ASTM A 666, type 304, dead soft, fully annealed. Provide sheet in 18 gauge thickness for jamb flashing.

D. Lead: Weight 4 lbs. per square foot.

E. Solder: ASTM D32, Alloy gauge 58, 50% tin, 50% lead.

F. Shop-Fabricated Scupper: Fabricate from 24 Gauge galvanized steel with Kynar 500 finish. Formed one-piece through wall scupper flashing with flange extending at least 4" in all directions from scupper and at least 4" onto roof surface (4" beyond roof cants at overflow scuppers). Basis of Design construction shall be patterned on a scupper as manufactured by OMG Roofing Products or approved equal. Provide with prefinished Kynar snap-on face trim in color as selected by the Architect.

G. One-Piece Gravel Stops: One-piece, metal gravel stop in section lengths not exceeding 12 feet, with a horizontal flange and vertical leg, terminating in a drip edge, and concealed splice plates of same material, finish, and shape as gravel stop. Provide matching corner units. Basis of Design construction shall be as profiled on the drawings, or shall be patterned after OMG Roofing Products "Safeguard NP Gravel Stop", or approved equal.
   1. Fabricate from minimum 24 gauge galvanized steel, unless noted otherwise.
   2. Corners: Mitered, preformed and continuously welded.
   3. Accessories: Fascia extenders with continuous hold-down cleats, as applicable.
   4. Finish for Galvanized Steel: Kynar coating in colors as selected by Architect.

H. Finish for Galvanized Steel: Kynar coating in colors as selected by Architect.

I. Nails for Sheet Metal Work: 10 Gauge galvanized ring type steel of sufficient length to adequately secure sheet metal work.

J. Aluminum Trim Fasteners: Exposed fasteners shall be aluminum or stainless steel. Unexposed fasteners may be cadmium or zinc plated steel in accordance with ASTM A164-55 and 165-55. Steel anchors shall be properly insulated from aluminum.

K. Roof Penetration Flashing: Lead coated copper 16 oz./SF. Roof Penetration Flashing: Lead coated copper 16 oz. /SF.

L. Through-Wall, Door/Window Sill and Head Flashings:
   1. Where embedded in masonry (not exposed to view): 3 oz. copper composite Multi-Flash 500 by York or approved equal. See Division 4 section “Unit Masonry”.
   2. Where exposed to view: Prefinished 24 gauge galvanized steel with PVDF coating in color(s) as selected by Architect. Provide with drip edges hemmed 1/2” on underside.

M. Metal Jamb Flashing: Provide 18 gauge stainless steel, with hemmed edge.

N. Reglets: Equal to Fry original metal reglet.

O. Counter Flashing. "Springlock Flashing" by Fry Reglet.

P. Sheet Metal Fasteners: Galvanized steel with washers where required.

Q. Hooded Pans with Pourable Sealant: As detailed in drawings, constructed of 20 gauge galvanized sheet steel, riveted and soldered watertight. Provide hooded pans at all new pipe, conduit, refrigerant line and other similar through-roof penetrations as necessary where power / condensate do not penetrate within RTU roof curbs. Bed flanges with plastic cement (Fed. Spec. SS-C-153, Type II) on top of roofing. Caulk around penetrations. Fill pans with roofing granules to 1" from top, and fill to the top with pourable sealant. Mold sealant to cone shape sloping to outside.
   1. Provide pans of adequate sizes for penetrations as indicated in Drawings, including space between penetrations within the same hooded pan.

2.02 FABRICATION

A. All exposed edges shall be hemmed 1/2" on underside.

2.03 ALUMINUM FINISHES

A. General: Comply with Aluminum Association's (AA) "Designation System for Aluminum Finishes: for finish designations and application recommendations.

B. High-Performance Organic Coating Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid chromate-fluoride-phosphate conversion coating; Organic Coating; as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's instructions.
   1. Fluoropolymer 2-Coat Coating system: Manufacturer's standard 2-coat, thermo cured system composed of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 605.2.
      a. Color and Gloss: As selected by Architect from manufacturer's full range of choices for color and gloss.

PART 3 - EXECUTION

3.01 INSPECTION OF SURFACES

A. Applicator responsible for inspecting substrates upon which sheet metal materials are to be placed for any defects or conditions that would impair finished installation. Application constitutes acceptance of the substrate.

3.02 APPLICATION

A. Details shown are design details, fabrication techniques, and methods as per SMACNA recommendations.

B. Proper and adequate provisions shall be made in fabrication, installing and fastening sheet metal work for expansion and contraction of metal and other materials entering into the work so that pulling, splitting, opening of joints, warpage or other failure of the work shall be prevented. Expansion joints in sheet metal placed not farther than 40 feet apart. Dissimilar metal surfaces contacting one another, protected by bituminous coating to prevent galvanic or corrosive action from occurring.

C. Counter flashing constructed in lengths not exceeding 10 feet and installed in receiver so that flashing lays tightly against base flashing and overlaps base flashings a minimum of 4 inches. Joints between sections shall be tight and lay flat. Metal at corners continuous. Bent, crimped or warped sections are not permitted.
   1. Coordinate counterflashings with roofing installation of termination bars at top edge of roofing base flashings.

D. Coping constructed in lengths not exceeding 10 feet. Joints between sections shall be tight and lay flat over splice plates. Coping shall be fastened with continuous clips both sides over 45 mil neoprene sheet. Bent, crimped or warped sections are not permitted. Metal at corners shall be soldered.

E. Metal gravel stop set over roofing in a bed of roofing cement troweled in place and secured by nailing 3" o.c. staggered and clipped to continuous galvanized cleat nailed on minimum of 3" centers. After setting gravel stops, strip in 2-ply roof flashing felts in roofing cement from peak of gravel stop to 6" past edge of flange into roof surface.

F. Install hooded sealant filled pans at equipment supports, pipes, conduits and other items penetrating roof or at items resting on roof without integral curbs and base flashing. Bed flanges with plastic cement (Fed. Spec. SS-C-153, Type II) on top of roofing. Caulk around

penetrations. Fill pans to 1" from top with roofing granules. Fill top inch of pans with pourable sealant and mold to cone shape sloping to outside.

3.03 INSTALLATION

A. General: unless otherwise indicated, install sheet metal flashing and trim to comply with performance requirements, manufacturer's installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Anchor units of Work securely in place by method indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weatherproof.
   1. All complete work shall be water and weathertight. Joints, cuts, miters, splices or other installation means made as neat as possible. Fastenings as inconspicuous as possible.

B. Install exposed sheet metal Work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicate, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

C. Expansion Provisions: Provide for thermal expansion of exposed sheet metal work. Space movement joints at maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less that 1 inch deep, filled with mastic sealant (concealed within joints).

D. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2 inches, except where pretinned surface would show in finished Work.
   1. Do not solder the following metals:
      a. Aluminum.
   2. Pretinning is not required for the following metals:
      a. Lead-coated copper.
   3. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

E. Copings: Install with concealed splice plates, preformed corners, and positive drainage (inward slope) on top surface. No exposed fasteners through copings allowed.

F. Sealed Joints: Form no expansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards. Fill joint with sealant and form metal to completely conceal sealant.
   1. Use joint adhesive for nonmoving joints specified not to be soldered.

G. Seams: Fabricate nonmoving seams in aluminum with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

H. Separations: Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with asphalt mastic or other permanent separation as recommended by manufacturer.
   1. Underlayment: Where installing stainless steel or aluminum directly on cementitious or wood substrates, install a slip sheet of red-rosin paper and a course of polyethylene underlayment.
   2. Bed flanges of Work in a thick coat of roofing cement where required for waterproof performance.

I. Roof-drainage System: Install drainage items fabricated from sheet metal, with straps, adhesives, and anchors recommended by SMACNA'S Manual or the item manufacturer, to drain roof in the most efficient manner. Coordinate roof-drain flashing installation with roof-drainage system installation. Coordinate flashing and sheet metal items for steep-sloped roofs with roofing installation.

J. Roof-Penetration Flashing; Coordinate roof-penetration flashing installation with roofing and installation of items penetrating roof. Install flashing as follows:
   1. Turn lead flashing down inside vent piping, being careful not to block vent piping with flashing.
   2. Seal and clamp flashing to pipes penetrating roof, other than lead flashing on vent piping.

K. Splash Pans: Install where downspouts discharge on low-sloped roofs, unless otherwise shown. Set in roof cement or sealant compatible with roofing.

L. Precast Concrete Splash Blocks: Install where downspouts discharge on grade unless otherwise shown.

3.04 FLASHING & COUNTERFLASHING REQUIREMENTS

A. Joints in thru-wall flashings and counterflashings shall be lapped 4" minimum with laps bedded in sealant.

B. Head and sill flashings shall not have joints and shall have sides turned up (edge dams) with all corners folded, not cut and shall extend 9" minimum beyond both sides of opening.

C. Head, sill and thru-wall flashings shall be set in a bead of sealant applied under the exterior edge of the flashing and on top of the masonry or lintel angle on which the flashing rests.

D. Penetrations in thru-wall flashing are not permitted. Vents in thru-wall flashing shall be completely flashed and water tight.

E. Metal reglets shall have a bead of sealant installed to complete system with counterflashing.

F. All thru-wall flashing shall extend through and up the interior face of exterior gypsum sheathing, as applicable.

G. Install metal jamb flashing, in material as noted, over adjacent air barrier system at jambs of curtainwall and other locations as shown on the drawings, as required to close openings to cavity wall. Mechanically attach with stainless steel fasteners and seal metal flashing to wall / air barrier with self adhering membrane flashing as specified in Division 07 Section - Modified Bituminous Sheet Air Barriers.

3.05 CLEANING AND PROTECTION

A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.

END OF SECTION 07 62 00

SECTION 07 71 00 - ROOF SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Pre-Manufactured Coping Systems.
   2. Reglets and counterflashings.

B. Related Sections:
   1. Division 06 Section - Rough Carpentry for wood nailers, curbs, and blocking.
   2. Division 07 Section - SBS-Modified Bituminous Membrane Roofing for roof edge flashing system.
   3. Division 07 Section - Flashing and Sheet Metal for custom and site-fabricated sheet metal copings, flashing and trim.
   4. Division 07 Section - Roof Accessories for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
   5. Division 07 Section - Joint Sealants for field-applied sealants between roof specialties and adjacent materials.

1.03 PERFORMANCE REQUIREMENTS AND QUALITY ASSURANCE

A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Preinstallation Conference: Conduct conference at Project site.
   1. Meet with Owner, Architect, Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects roof specialties including installers of roofing materials and accessories.
   2. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
   3. Review special roof details, roof drainage, and condition of other construction that will affect roof specialties.

C. Sheet Metal Standard for Flashing and Trim: Comply with the latest edition of NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
   1. Sheet Metal Standard for Copper: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

D. Wind-Uplift Resistance: Provide metal roof edge flashing assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
   1. Uplift Rating: UL 90.

E. FM Approvals Listing: Manufacture and install copings and roof edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, **Class 1A-90** Identify materials with name of fabricator and design approved by FM Approvals.

F. SPRI Wind Design Standard: Manufactured copings and roof edge flashings for low slope roofs shall be designed and installed for wind loads in accordance with IBC Chapter 16, including local code amendments as applicable, and tested for resistance in accordance with Test Methods RE-1, RE-2 and RE-3 of ANSI/SPRI/FM 4435/ES-1.
   1. Roof edge products shall be UL Classified by Underwriters Laboratories, Inc. or other building code approved 3rd party verification of compliance with the ANSI/SPRI/FM 4435/ES-1 Wind Design Standard.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss. Account for temperature change of 120 deg F ambient, 180 deg F material surfaces.

H. Installer: Engage an experienced installer who has completed similar work of a comparable scale with a record of successful performance.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof specialties. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work. Include the following:
   1. Details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.
   2. Pattern of seams and layout of fasteners, cleats, clips, and other attachments.
   3. Details of termination points and assemblies, including fixed points.
   4. Details of special conditions.

C. Samples for Initial Selection: For each type of roof specialty indicated with factory-applied color finishes.

D. Samples for Verification: For copings, roof-edge flashings, reglets and counterflashings made from 12-inch lengths of full-size components including fasteners, cover joints, accessories, and attachments.

1.05 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for copings and roof-edge flashings.

B. Warranty: Sample of special warranty.

1.06 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.07 WARRANTY

A. Coping System: Special Performance / 20-Year Warranty: Manufacturer shall guarantee that a coping system up to 32" wide, when installed per manufacturer’s instructions, will not blow off, leak, or cause membrane failure, even in wind conditions up to 110 mph, or the manufacturer shall at their option repair or replace their materials.

B. Furnish manufacturer's standard 20 year warranty stating architectural fluorocarbon finish will be:
   1. Free of fading of color change in excess of 6 NBS units as measured per ASTM D 2244-68;

2. Will not chalk in excess of numerical rating of 7 when measured in accordance with standard procedures specified in ASTM D 659-74;
3. Will not peel, crack, chip, or de-laminate.

C. Furnish written warranty signed by applicator for two year period from date of substantial completion of building covering repairs required to maintain roof and flashings in watertight conditions.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.

B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof specialties installation.

PART 2 - PRODUCTS

2.01 EXPOSED METALS

A. Galvanized steel G90 with factory applied Kynar 500/Hylar 500 finish.

2.02 CONCEALED METALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation.

2.03 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
   1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F.
   2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F.
   3. Products: Subject to compliance with requirements, provide one of the following:
      a. Carlisle Coatings & Waterproofing; CCW WIP 300HT.
      b. Grace Construction Products, a unit of W. R. Grace & Co.; Ultra.
      c. Henry Company; Blueskin PE200 HT.
      d. Owens Corning; WeatherLock Metal High Temperature Underlayment.

2.04 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:
   1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.

C. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

E. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.05 COPINGS

A. Copings: Manufactured coping system consisting of formed-metal coping cap in section lengths not exceeding 10 feet, concealed anchorage; corner units, end cap units, and concealed splice plates with same finish as coping caps.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   2. Basis-of-Design Product: Subject to compliance with requirements, provide OMNG Roofing Products, "Permasnap-2" or "Permasnap-2 Plus" as recommended by manufacturer for specified performance criteria, or approved equal by another manufacturer.
   3. Coping-Cap Material: Galvanized steel, minimum of 22 gauge or greater where required by coping size or performance criteria, G90 with factory applied Kynar 500/Hylar 500 finish.
      a. Color: As selected by Architect from manufacturer's full range.
   4. Corners: Factory pre-formed, mitered and continuously welded.
   5. Splice Plates: Concealed, of same material & finish as coping.
   6. Special Fabrications: Two-way sloped coping cap.
   7. Coping-Cap Attachment Method: Face leg hooked to continuous cleat with snap-on back leg fastener exposed, fabricated from coping-cap material.
   8. Cleats are minimum of 20ga. galvanized steel. Chairs are metal in the same color and finish as the coping cap. Fabricated to the wall width required between 6" and 32".
   9. Provide thicker gauges of cap and cleats than the minimum gauges as required to meet referenced standards and performance criteria. Contractor is responsible to determine where thicker gauges are required and include in their bid.

2.06 REGLETS AND COUNTERFLASHINGS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Fry Reglet Corporation or comparable product by one of the following:
   1. OMG Roofing Products.
   2. MM Systems Corporation.

B. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:
   1. Galvanized steel (24 ga.) G90 with factory applied Kynar 500/Hylar 500 finish.
   2. Corners: Factory mitered and mechanically clinched and sealed watertight.
   3. Surface-Mounted Type: Provide reglets with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
   4. Masonry Type, Embedded: Provide reglets with offset top flange for embedment in masonry mortar joint.

C. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches and in lengths not exceeding 10 feet designed to snap into reglets and compress against base flashings with joints lapped, from the following exposed metal:
   1. Galvanized steel (24 ga.) G90 with factory applied Kynar 500/Hylar 500 finish.
      a. Color: As selected by Architect from manufacturer's full range.

D. Accessories:
   1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.
   2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

2.07 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.

C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

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

3.02 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Install wrinkle free. Apply primer if required by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply in shingle fashion to shed water. Overlap edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

3.03 INSTALLATION, GENERAL

A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete roof-specialty systems.

1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
2. Provide uniform, neat seams with minimum exposure of solder and sealant.
3. Install roof specialties to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
4. Torch cutting of roof specialties is not permitted.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
1. Coat concealed side of stainless-steel roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of self-adhering, high-temperature sheet underlayment.
3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.
1. Space movement joints at a maximum of 10 feet with no joints within 18 inches of corners or intersections unless otherwise shown on Drawings.

2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fastener Sizes: Use fasteners of sizes that will penetrate wood blocking or sheathing not less than 1 recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal joints with elastomeric sealant as required by roofing-specialty manufacturer.

F. Seal joints as required for watertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.

3.04 COPING INSTALLATION

A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor copings to meet performance requirements.
1. The first cleat/chair set should be installed with the center line of the cleat set to the miter leg length (see chart on front page) and 24" (300mm) from the end of a wall. Install cleats/chairs sets at all corners and ends first, then work along the wall to the center locating sets every 60" on center for walls less than 17" and 40" on center for walls 17" - 32". Adjust the cleat location in the middle of a run to fit a short coping length. This procedure will provide a symmetrical appearance of the installed coping. Install metal gutter chair/concealed joint covers at joint locations. Hook coping face leg over the cleat face (front) leg and swing over the top. Snap the roof side (back) leg by pressing firmly down on the back edge directly over the cleat chair sets. Leave a 1/4" gap at each joint for thermal movement. Anchor shall be placed per manufacturer's required spacing that meets performance requirements.

3.05 REGLET AND COUNTERFLASHING INSTALLATION

A. General: Coordinate installation of reglets and counterflashings with installation of base flashings.

B. Embedded Reglets: See Division 04 Section - Unit Masonry Assemblies for installation of reglets.

C. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches over top edge of base flashings.

D. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches and bed with elastomeric sealant. Fit counterflashings tightly to base flashings.

3.06 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.

D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07 71 00

SECTION 07 72 00 - ROOF ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. General Coordination Procedures, (Reference Specification Section 01 31 00) General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

A. Section Includes:
   1. Provide roof accessories including roof hatch, pre-fabricated roof curbs, pipe pedestals, pipe portals and other items as indicated on the drawings.

B. Related Sections include the following:
   1. Division 05 Section - Metal Deck.
   2. Division 05 Section - Metal Fabrications, for coordination with roof access ladders.
   3. Division 06 Section - Rough Carpentry, for wood blocking.
   4. Division 07 Section - Roofing Section(s).
   5. Division 07 Section - Sheet Metal Flashing and Trim.
   6. Division 07 Section - Roof Specialties.
   7. Division 07 Section - Sealants.
   8. Division 22 Sections for Plumbing.
   9. Division 23 Sections for Mechanical.
   10. Division 26 Sections Electrical.

1.03 QUALITY ASSURANCE

A. Comply with "NRCA Roofing and Waterproofing Manual" for installation of units.

1.04 SUBMITTAL

A. Submit manufacturer technical product data and rough-in diagrams, details.

1.05 PRODUCT DELIVERY

A. Deliver products in manufacturers original unopened packages, clearly marked with brand name and model number.

B. Store materials on clean, raised platforms with weather protective covering when stored outdoors.

1.06 WARRANTY

A. Manufacturer shall guarantee against defects in material and workmanship for a period of five years.

B. **[Metal roof pipe boot warranty: Manufacturer's standard 20 year warranty]**.

1.07 PROJECT CONDITIONS

A. Any equipment curb heights indicated in Drawings are minimum curb heights required in general. Taller curbs may be required for minimum height above adjacent roofing for roof warranty, including tapered insulation and crickets. All curbs shall be tall enough to accommodate minimum curb height, or minimum heights above roof as indicated in Drawings, or minimum 8" above highest adjacent roof surface, whichever is greatest. Coordinate with roofing installer to confirm total curb heights required.

B. Do not install materials during inclement weather or when air temperature may fall below 40 ° F, including wind chill.

C. Do not install materials over damp, frozen or otherwise unsuitable surface.

PART 2 - PRODUCT

2.01 MANUFACTURERS

A. Subject to compliance with project requirements, manufacturer's offering Products which may be incorporated in the Work include the following:
   1. BILCO Company, New Haven, CT, (203) 934-6363
   2. Custom Curb, Incorporated, Chattanooga, TN (800) 262-6669.
   3. Kentuckiana Curb Company, Louisville, KY (800) 382-2872.
   4. The Pate Company, Broadview, IL (800) 243-3018.
   5. Thybar Corporation, Addison, IL (708) 543-5300.

B. Division 01 Section - Product Requirements: Product options and substitutions. Substitutions: Permitted.

2.02 MATERIALS

A. Prefabricated Roof Equipment Support: Welded 18 gauge welded galvanized steel and integral base plate with factory installed 2 x 4 pressure treated wood nailer, and heavy gauge galvanized steel counterflashing. Reinforcing on sides greater than 36". Supports to be provided as shown on drawings. Unit shall be tapered to provide level rooftop equipment, as manufactured by the Pate Co., Model #ES-2, or approved equal.

2.03 FABRICATION

A. Curb Cap Flashings: All curb cap flashings without exception shall be one piece galvanized steel construction with no rivets or sealant joints, and with pre-punched holes on vertical surface for mechanical fastener attachment to curbs. Except for equipment support curbs required to be a level mounting surface, top side of curb cap flashings shall have slight slope to drain away from penetrations on all sides. Penetration openings shall be fabricated to dimensions of penetrating items and shall turn up integral with flashing cap at least one inch, with a turned out lip for applying sealant, unless otherwise approved by Architect.

PART 3 - EXECUTION

3.01 COORDINATION

A. Coordinate between trades as required to ensure waterproof installation acceptable to roofing installer and Manufacturer.
   1. Ensure roof curbs meet minimum height requirements above adjacent roofing, including insulation thickness, tapered insulation, and crickets.
   2. Verify and coordinate actual roof slopes as required for level top of curbs.
   3. Coordinate installation of roofing membrane pads under all support pedestals.

3.02 INSPECTION

A. Examine areas to receive roof accessories to insure work of preceding trades is completed. Check surfaces to see that they are uniform in place, free from grease, oil or other debris which would affect proper installation. Application constitutes acceptance of substrate conditions.

3.03 INSTALLATION

A. Accessories installed in accordance with current printed recommendations of Manufacturer and to roofing manufacturer's requirements.

B. Coordinate installation of accessories with roof and flashing installations. Provide weathertight installation.

C. Accessories secured in place to withstand wind loads in accordance with the local building codes.

D. Fasteners, General: All fasteners shall be installed straight and to make proper seal at gaskets. No fasteners of any sort are allowed through top side of curb cap flashings. All fasteners in flashing caps shall be through vertical sides only. No fasteners of any sort are allowed through roofing membranes or materials unless specifically approved in writing by roofing installer and manufacturer, and approved by Architect.

END OF SECTION 07 72 00

SECTION 07 84 13 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Furnish all labor, materials, tools, equipment and related items required for the complete installation of firestopping at penetrations through rated partitions and floors.

B. Related Sections include the following:
   1. Division 03 Section - Concrete Floor.
   2. Division 07 Section - Fire-resistive Joints.
   3. Division 09 Section - Drywall Partitions.

1.03 STANDARDS

A. All work under this section shall conform to the requirements of the Underwriters' Laboratories, Inc., the National Board of Fire Underwriters and the local building code. Where requirements specified differ from the requirements of any authorities having jurisdiction, the more stringent requirements shall apply.

B. Firestopping system shall be a complete system of materials supplied by one manufacturer.

1.04 QUALITY ASSURANCE

A. Qualifications of Installer:
   1. Five years experience in performing installation of materials with similar quantities of fireproofing materials.
   2. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

B. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

C. Requirements of regulatory agencies:
   1. Building code requirements of the municipality for fire resistance ratings of areas to receive fireproofing materials.
   2. Underwriters' Laboratories, Inc.: Classification marking.
   3. Acceptance by ICBO, BOCA and SBCCI as described by National Evaluation Service Report, NER-332.

D. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:

1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
2. Penetration firestopping is identical to those tested per testing standard referenced.

E. Testing:
1. Fire resistant rating of assemblies - ASTM E-814.
2. Compound shall meet all requirements of UL 1479.

1.05 SUBMITTALS

A. Test Reports
1. Submit copies of fire test reports of fireproofing installation to substrate materials required.
2. Submit certified test reports of acceptable testing agencies which perform testing in accordance with ASTM E-119 and E-84.

B. Manufacturer's Instruction: Furnish manufacturer's printed material specifications and installation instruction for each type of fireproofing.

C. Certificates:
1. Furnish manufacturer's certification that materials meet or exceed specification requirements.
2. Furnish applicators certification that material has been completed as specified to meet fire resistance ratings and application requirements.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original, unopened packages bearing name of manufacturer and product identification.

B. Reject damaged packages found unsuitable for use and remove from job site.

C. Store materials off ground, under cover, and away from damp surfaces.

D. Keep materials dry at all times.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

A. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
1. Horizontal assemblies include floors, floor/ceiling assemblies, & ceiling membranes of roof/ceiling assemblies.
2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
3. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.

B. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.
1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at 0.30-inch wg at both ambient and elevated temperatures.

C. W-Rating: Provide penetration firestopping showing no evidence of water leakage when tested according to UL 1479.

D. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

E. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   1. Sealants: 250 g/L.
   2. Sealant Primers for Nonporous Substrates: 250 g/L.
   3. Sealant Primers for Porous Substrates: 775 g/L.

2.02 MATERIALS

A. Safing Insulation: Forming material, minimum 3" unfaced safing insulation with a nominal density of 4 pcf, and bearing the UL Classification Marking shall be "Thermafiber" as manufactured by Owens Corning.

B. Compound: Pliable, non-toxic, non-combustible, non-asbestos, low density, lightweight compound shall be "Firecode" as manufactured by USG Corp., "Flame Stop V" as manufactured by Flame Stop Inc. or "Metacaulk" as manufactured by Rectorseal.

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify that all substrates to receive firestopping system are constructed according to the Construction Documents and acceptable to receive fire stop materials.

3.02 APPLICATION

A. Safing Insulation: Cut safing insulation slightly wider than the opening. Compress and tightly fit min. 2 1/2" or 3" thickness of insulation with nominal density of 4 pcf completely around penetrant.

B. Firestopping Compound: Trowel apply the compound from its container and work into the penetration opening. Apply compound to minimum 1/2" to 1" thickness on top of safing insulation. Ensure that compound is in contact with all surfaces and that entire opening is filled with safing and compound. Utilize appropriately rated product for specific rated partition application.

END OF SECTION 07 84 13

SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes: Provide sealant required to close joints that would allow moisture or air to enter structure between fixed materials, as shown on the drawings and as herein specified, including but not limited to:
   1. Sealing of interior perimeter joints of window framing, door frames, and other openings in walls.
   2. Setting of thresholds in sealant.
   3. Sealing of joints between countertops and wall surfaces for a sanitary joint.
   4. Sealing of joints of every nature and description that would allow moisture or air penetration.
   5. Sealing of joints indicated to be caulked or sealed whether specifically mentioned herein or not.
   6. Sealing around all pipe, duct and vent penetrations.
   7. Sealing at paving joints.

B. Related Sections include the following:
   1. Division 04 Section - Unit Masonry Assemblies.
   2. Division 06 Section - Interior Architectural Woodworking.
   3. Division 07 Section - Sheet Metal Flashing and Trim.
   4. Division 07 Section - Metal Panels.
   5. Division 07 Section - Roofing.
   6. Division 07 Section - Expansion Control.
   7. Division 08 Section - Aluminum Entrances and Storefront.
   8. Division 08 Section - Aluminum Curtain Wall.
   9. Division 09 Section - Gypsum Board Assemblies.
   10. Division 09 Section - Painting.
   11. Division 21 Section - Fire Suppression.
   12. Division 22 Section - Plumbing.
   13. Division 23 Section - Mechanical.
   14. Division 26 Section - Electrical.
   15. Division 32 Section - Paving.

1.03 JOB CONDITIONS

A. Environmental Conditions: Sealant work not permitted when air temperature is below 40 degrees F.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's product specifications, color range, handling/installation/curing instructions, and performance tested data sheets for each elastomeric product or joint backing material.

B. Samples: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Submit samples of joint backing material.

1.05 WARRANTY

A. The Contractor shall submit, in writing, a warrant that all sealant work executed under this Section shall be free from defects in materials and workmanship for a period of two (2) years from date of acceptance of the Project, and he shall remedy any defects in the sealant work during the warranty period.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   1. Architectural Sealants: 250 g/L.
   2. Sealant Primers for Nonporous Substrates: 250 g/L.
   3. Sealant Primers for Porous Substrates: 775 g/L.

2.02 MATERIALS

A. Chemical Compatibility, General: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
   1. Where new sealants will adjoin existing sealants to remain, confirm chemical compatibility of sealant type prior to preparing submittals. In the event of chemical incompatbility, suggest alternate compatible sealant products for those applications.

B. Primers: Non-staining type as recommended by sealant manufacturer for each working surface. Material shall not leave residue or stain on adjacent surfaces. Each joint must be primed prior to sealing.

C. Sealant for Interior and Exterior Masonry Control Joints: 1 part ultra low modulus silicone sealant equivalent to "Spectrum 1" by Tremco, or "890 NST" by Pecora. Color to match adjacent surfaces.

D. Sealant for Re-glazing: Medium modulus silicone sealant shall be Tremco's "Spectrem 2", or approved equal. Color as selected by Architect.

E. Sealant for Exterior Concrete Paving and Sidewalk Joints: Two part urethane (self leveling) sealant equal to "MasterSeal SL-2" by Sonneborne / BASF Chemical Co., "Urexpan NR-200" by Pecora, or "THC-900" Tremco. Provide non-sag product at joints in vertical curbs, equal to "MasterSeal NP-2" by Sonneborne / BASF.

F. Caulking for Interior Joints: One part acrylic latex sealant equivalent to "AC-20" by Pecora, "Tremflex 834" by Tremco, "Acrylic Latex" caulk by DAP, or "Sonolac" by Sonneborn.

G. Caulking for Countertop Joints: One-part clear silicone sealant, 860 by Pecora, or equal.

H. Precompressed Expanding Foam Sealant: Shall be Gray "Illmod 600" as manufactured by "Tremco", Beachwood, Ohio or approved equal.

I. Sealant for Gypsum Board joints for Acoustic Construction: USG "Acoustical Sealant" or equal by Tremco or Pecora.

J. Joint Backing: ASTM C1330, Non-staining closed cell polyethylene foam rod oversized 30% to 50%, equal to "MasterSeal 920" by BASF.

K. Foam Backer Rod for Acoustic Construction: ASTM C1330, Closed cell polyethylene,. Acceptable Manufacturers: ITP, Nomeco, or approved equal. (Available through Tom Brown, Inc. 800-446-2298)

L. Solvents and Cleaning Agents: Of a type specifically recommended by sealant manufacturer.

PART 3 - EXECUTION

3.01 INSPECTION

A. Applicator shall examine surfaces receiving sealant or caulking for any defects or joint sizes which would not structurally perform or for any unusual conditions which would interfere with proper installation of sealant or caulking.

3.02 PREPARATION

A. Thoroughly clean all joints removing all foreign matter such as dust, oil, grease, dirt or other loose particles. Provide and apply non-staining primer as required by conditions and sealant manufacturer.

B. When primer is dry, compress backup and insert into joint leaving 1/4" to surface open for joint sealing or leave open 1/2 of joint width, but not less that 1/4".

C. Completely cut smooth and remove projection of existing gasket and/or sealant material at door and window framing to remain to achieve sound substrate for application.

3.03 APPLICATION

A. It is the intent and purpose and interpretation of this specification that in all areas, joints sealed shall be rendered structurally sound and impervious to the passage of water, moisture and dust.

B. Follow sealant manufacturer's instructions regarding mixing, surface application, priming and application procedure.

C. Sealant shall be applied under pressure with a hand or power activated gun having a nozzle of proper size to entirely fill joint void and shall be forced into joints with sufficient pressure to expel air and fill the joints solidly. All joint surfaces shall be neatly tooled to a smooth surface, free of wrinkles and result in a flush joint when dry.

D. Apply sealants when the ambient temperature is between 40° and 100° F.

E. All junctures between countertops, back splashes and walls shall be caulked with silicone sealant providing a sanitary tight joint.

F. All junctures between piping and substrate of partitions, floors and ceiling shall be caulked.

G. Precompressed expanding foam sealant shall be installed per manufacturer's requirements at all vertical expansion joints as noted on Drawings.

H. Apply sealant bead at least 1/2 inch thick under each edge of threshold. Remove excess and neatly point.

I. Apply sealant between brick veneer and coping on outside face of exterior wall.

J. Caulk perimeter of window frame, door frame or other items penetrating, intersecting or abutting walls, ceilings, floors, etc.

K. Prime surface as required and apply sealant at all glazing, at metal to metal and glass to metal joints within the system.

L. Apply bead of sealant at base of wall board.

M. Furnish and install acoustical sealant at the following locations:
   1. All penetrations of partition, wall, and floor construction by ductwork, conduit, piping, or structure.
   2. All termination of partitions enclosing Noise Critical Spaces to abutting construction (e.g. partitions, structure, etc.)
   3. Both sides of door frames to abutting construction where doors are scheduled to have acoustical seals.
   4. Both sides of window frames to adjacent construction
   5. Perimeter of and penetrations through sound isolating ceilings, roof systems, and floor systems.

N. Backer Rod shall be used in all joints, product to be constructed of closed cell foam, or appropriate resilient material for sealant. Dimension shall be minimum 30% greater than joint width, unless otherwise indicated on details.

O. Fill paving sealant full width of joint, and to within 1/8" of paving surface.

3.04 CLEANING

A. Clean adjacent surfaces free of sealant or soiling resulting from this work as work progresses. Use solvent or cleaning agent as recommended by sealant manufacturer. All finished work shall be left in a neat, clean condition.

END OF SECTION 07 92 00

SECTION 07 95 00 - EXPANSION CONTROL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections Include the Following:
   1. Division 09 Section - Resilient Flooring.
   2. Division 09 Section - Acoustical Ceilings.
   3. Division 09 Section - Gypsum Board Assemblies.

1.02 ACTION SUBMITTALS

A. Shop Drawings: For each expansion control system specified, include details showing plans, elevations, sections, splices, blockout requirements, and attachments to other work, as needed to coordinate the work. Indicate locations where tile or terrazzo work may require replacement of existing expansion joint covers. Coordinate work as required with structural and architectural drawings for slab depressions or recesses needed.

B. Samples: For each proposed expansion control system, provide sample for approval of color and finish specified.

1.03 COORDINATION

A. Coordinate with other trades to determine proper installation, removal and reinstallation, or replacement of expansion joint covers. Ensure substrates are prepared to receive covers as required.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

A. General: Provide expansion control systems of design, basic profile, material, and operation indicated. Provide units with capability to accommodate variations in adjacent surfaces.
   1. Furnish units in longest practicable lengths to minimize field splicing. Install with hairline mitered corners where expansion control systems change direction or abut other materials.
   2. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion control.

2.02 INTERIOR EXPANSION CONTROL SYSTEMS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated, as manufactured by Balco, Inc., or approved equal by one of the following:
   1. Architectural Art Mfg., Inc.; Division of Pittcon Industries.
   2. Construction Specialties, Inc.
   3. JointMaster/InPro Corporation.
   4. Nystrom, Inc.

B. Source Limitations: Obtain expansion control systems from single source and from single manufacturer.

C. Floor-to-Floor:
   1. Basis-of-Design Product:

a. Terrazzo to Terrazzo: Balco Inc., "NBAF-2".

2. Design Criteria:
   a. Joint Width: As indicated on Drawings, or to match existing conditions.
   b. Type of Movement: Thermal, or to suit existing conditions.
3. Type: As shown on Drawings.
   a. Cover-Plate, Glide-Plate or Center Plate Design: Plain, or as shown on drawings.
      1) Recess Depth: As required to accommodate adjacent flooring

D. Wall-to-Wall:
1. Basis-of-Design Product:
   a. Gypsum Board or Plaster (Field): Balco Inc., "WD-2".
2. Design Criteria:
   a. Nominal Joint Width: As indicated on Drawings, or to match existing conditions.
   b. Type of Movement: Thermal, or to suit existing conditions.
3. Type: Accordion, or Glide Plate, as indicated.
   a. Metal: Aluminum.
      1) Finish: As selected by Architect from Manufacturer's standards.
      2) Color: As selected by Architect from Manufacturer’s standards.

E. Ceiling-to-Ceiling:
1. Basis-of-Design Product: Balco Inc., "AC-2".
2. Design Criteria:
   a. Nominal Joint Width: As indicated on Drawings, or to match existing condition.
   b. Type of Movement: Thermal, or to suit existing conditions.
3. Type: Accordion.
   a. Metal: Aluminum.
      1) Finish: As selected by Architect from manufacturer's standards.
      2) Color: As selected by Architect from manufacturer’s standards.

F. Ceiling-to-Wall:
1. Basis-of-Design Product: Balco Inc., "WDC-2".
2. Design Criteria:
   a. Nominal Joint Width: As indicated on Drawings, or to match existing condition.
   b. Type of Movement: Thermal, or to suit existing conditions.
3. Type: Snap On
   a. Metal: Aluminum.
      1) Finish: As selected by Architect from manufacturer's standards.
      2) Color: As selected by Architect from manufacturer’s standards.

2.03 EXTERIOR EXPANSION CONTROL SYSTEMS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated, as manufactured by Balco, Inc., or approved equal by one of the following:
1. Construction Specialties, Inc.
2. MM Systems, Inc.

B. Source Limitations: Obtain expansion control systems from single source and from single manufacturer.

C. Wall to Wall
1. Basis of design Product, Balco Inc., “9WC-7”
   a. Nominal Joint Width : As Indicated on drawings, or to match existing condition.
2. Type: Metal Cover
   a. Metal: Aluminum.
      1) Finish: As selected by Architect from Manufacturer's standards.

2) Color: As selected by Architect from Manufacturer's standards.

D. Wall to Roof
   1. Basis of design Product, Balco Inc., "FRE-8"
      a. Nominal Joint Width : As Indicated on drawings, or to match existing condition.
   2. Type: Metal Cover
      a. Metal: Aluminum.
         1) Finish: As selected by Architect from Manufacturer's standards.
         2) Color: As selected by Architect from Manufacturer's standards.
      b.

2.04 MATERIALS

A. Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063-T5 for extrusions; ASTM B 209 (ASTM B 209M), Alloy 6061-T6 for sheet and plate.
   1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.

B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M.

C. Accessories: Manufacturer's standard anchors, clips, fasteners, and other accessories as indicated or required for complete installations.

PART 3 - EXECUTION

3.01 PREPARATION

A. Prepare substrates according to expansion control system manufacturer's written instructions.
   1. Coordinate Dimensional control with Wood Flooring. Coordinate with other trades to route edge of wood flooring as required for flush installation.

B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion control systems.

C. Cast-In Frames: Coordinate and furnish frames to be cast into concrete.

3.02 INSTALLATION

A. Comply with manufacturer's written instructions for storing, handling, and installing expansion control systems and materials unless more stringent requirements are indicated.

B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion control systems.
   1. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
   2. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation. Notify Architect where discrepancies occur that will affect proper expansion control system installation and performance.
   3. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
   4. Repair or grout blockout as required for continuous frame support using nonmetallic, shrinkage-resistant grout.
   5. Install frames in continuous contact with adjacent surfaces.
      a. Shimming is not permitted.
   6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches from each end and not more than 24 inches o.c.

C. Seals in Metal Frames: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.

1. Provide in continuous lengths for straight sections.
2. Seal transitions according to manufacturer's written instructions. Vulcanize or heat-weld-field-spliced joints as recommended by manufacturer.
3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.

D. Terminate exposed ends of expansion control systems with field- or factory-fabricated termination devices.

3.03 PROTECTION

A. Do not remove protective covering until finish work in adjacent areas is complete.

B. Protect the installation from damage by work of other Sections.

END OF SECTION 07 95 00

SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Solid-core doors with wood-veneer faces.
   2. Factory finishing of flush wood doors.
   3. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Sections:
   1. Division 04 Section "Unit Masonry Assemblies".
   2. Division 05 Section "Light Gauge Metal Framing".
   3. Division 08 Section "Metal Doors and Frames".
   4. Division 08 Section "Door Hardware".
   5. Division 08 Section "Glazing" for glass view panels in flush wood doors.
   6. Division 09 Section "Gypsum Board Assemblies".
   7. Division 09 Sections "Painting" for field finishing and touch-up of wood doors.

1.03 ACTION SUBMITTALS

A. Concurrent Review: Submit all door-related submittals together for concurrent review.

B. Product Data: For each type of door indicated. Include details of core and edge construction, louvers, and trim for openings. Include factory-finishing specifications.

C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
   1. Indicate dimensions and locations of mortises and holes for hardware.
   2. Indicate dimensions and locations of cutouts.
   3. Indicate requirements for veneer matching.
   4. Indicate doors to be factory finished and finish requirements.
   5. Indicate fire-protection ratings for fire-rated doors.

D. Samples for Initial Selection:
   1. For factory-finished doors.
   2. Manufacturer's samples or selectors for louvers, frames, and other prefinished materials as applicable.

E. Samples for Verification:
   1. Factory finishes applied to actual door face materials, approximately 6 by 8 inches, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.
   2. Plastic laminate, 6 inches square, for each color, texture, and pattern selected.
   3. Samples for frames for louvers and light openings, 6 inches long, for each material, type, and finish required.

1.04 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

B. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain flush wood doors and wood paneling from single manufacturer.

B. Quality Standard: In addition to requirements specified, comply with AWI's "Architectural Woodwork Quality Standards Illustrated."
   1. Certification:
      a. Provide AWI Quality Certification Labels or an AWI letter of licensing for Project indicating that doors comply with requirements of grades specified.
      b. Provide WI-Certified Compliance Certificate indicating that doors comply with requirements of grades specified.
      c. Provide WI-Certified Compliance Certificate for installation.

C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Deliver doors to building after wet trades have been completed and building is within normal occupancy humidity conditions. Doors shall be delivered in manufacturer's name and identifying symbol on covering. Doors shall be stored flat with protective coverings provided to protect surfaces. Doors shall not be dragged over one another.

C. Mark each door on top or bottom rail with opening number used on Shop Drawings.

1.07 PROJECT CONDITIONS

A. Comply with Manufacturer's environmental limitations.

B. Coordination:
   1. The Contractor shall provide door manufacturer with approved hardware schedules, templates and hand for all doors. Contractor shall advise door manufacturer of any changes after information has been forwarded. Contractor will be completely responsible for coordination between hardware, door and frame manufacturers. Any materials not properly coordinated shall be replaced by the Contractor at his own expense.
   2. Door manufacturer shall be responsible for properly coordinating information received by him so that doors are properly finished, machined and ready to hang.

1.08 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
      b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
   2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
   3. Warranty Period for Solid-Core Exterior Doors: Five years from date of Substantial Completion.
   4. Warranty Period for Solid-Core Interior Doors: Life of installation.
   5. Warranty Period for Hollow-Core Interior Doors: Two year(s) from date of Substantial Completion.

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. Masonite
   2. Curtis Corp.
   3. Eggers Industries.
   4. Graham; a Masonite company.
   5. Haley Brothers, Inc.
   6. VT Industries Inc.

2.02 DOOR CONSTRUCTION, GENERAL

A. Low-Emitting Materials: Fabricate doors with adhesives and composite wood products that do not contain urea formaldehyde.

B. WDMA I.S.1-A Performance Grade: Extra Heavy Duty

C. Fire-Protection-Rated Doors: Doors noted to have a specific hourly label, fabricated in accordance with Underwriters' Laboratories requirements for label indicated. Provide core specified or mineral core as needed to provide fire-protection rating indicated.
   1. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
   2. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
      a. Finish steel edges and astragals to match door hardware (locksets or exit devices).

D. Mineral-Core Doors:
   1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
   2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware.
   3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

E. Hollow-Core Doors:
   1. Construction: Institutional hollow core.
   2. Blocking: Provide wood blocking with minimum dimensions as follows:
      a. 5-by-18-inch lock blocks at both stiles.

2.03 VENEERED-FACED DOORS FOR TRANSPARENT FINISH

A. Finish for Veneer-Faced Doors:
   1. Grade: Premium, with Grade AA faces.
   2. Species: Red oak to match accent woodwork.
   3. Cut: Rift cut**.**
   4. Match between Veneer Leaves: Book match.
   5. Assembly of Veneer Leaves on Door Faces: Balance match.
   6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.

7. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
8. Blueprint Match: Where indicated, provide doors with faces produced from same flitches as adjacent wood paneling and arranged to provide blueprint match with wood paneling. Comply with requirements in Division 06 Section "Wood Paneling."

B. Interior Solid-Core Doors:
1. Exposed Vertical Edges: Same species as faces.
2. Core: Particleboard Construction: Five plies. Stiles and rails are bonded to core, then entire unit abrasive planed before veneering. Faces are bonded to core using a hot press.

C. Interior Hollow-Core Doors:
1. Exposed Vertical Edges: Same species as faces
2. Construction: Seven plies.

2.04 FABRICATION

A. Prefit and pre-machine wood doors at the factory.

B. Comply with the tolerance requirements of NWMA for prefitting. Machine doors for hardware requiring cutting of doors. Comply with final hardware scheduled and door frame shop drawings, and with hardware templates and other essential information required to ensure proper fit of doors and hardware.

C. Take accurate field measurements of hardware mortises in metal frames to verify dimensions and alignment before proceeding with machining in the factory.

D. Transom and Side Panels: Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.

E. Openings: Cut and trim openings through doors in factory.
1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Provide flush edgings for wood doors receiving panic devices or other hardware where typical molding would conflict with hardware. Coordinate with door hardware.

2.05 SHOP PRIMING

A. Trim and touch-up for Transparent Finish: Shop prime doors, light beads and other trim pieces with stain (if required), other required pretreatments, and first coat of finish as specified in Division 09 Section "Painting". Seal all four edges, edges of cutouts, and mortises with first coat of finish.

2.06 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Finish doors at factory

C. Transparent Finish:
1. Grade: Premium
2. Finish: AWI conversion varnish
3. Staining: Match wood paneling
4. Effect: Filled finish.
5. Sheen: Semigloss.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine doors and installed door frames before hanging doors.
   1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
   2. Reject doors with defects.

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

3.02 INSTALLATION

A. Hardware: For installation, see Division 08 Section "Door Hardware."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
   1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.

C. Clearance Tolerances for Factory Fitted Doors: Align in frames for uniform clearance at each edge.
   1. Provide 1/8 inch at heads, jambs, and between pairs of doors.
   2. Allow maximum of 3/16" over threshold or saddle.
   3. Allow maximum of 1/2" over decorative floor coverings.
   4. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.

D. Clearance Tolerances for Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
   1. Allow maximum of 3/16" at jamb and head.
   2. Allow maximum of 1/4" over threshold or saddle.
   3. Allow maximum of 1/2" over decorative floor coverings.
   4. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.

E. Clearance Tolerances for Fire-Rated Doors: Install in accordance with NFPA 80 for fire rated doors, and the following maximum clearances, whichever is more stringent:
   1. 1/8" between door and frame.
   2. 3/8" between door bottoms and decorative floor finish.
   3. 1/8" between doors for pairs of doors.
   4. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.

F. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.03 ADJUSTING

A. Operation: Re-hang or replace doors that do not swing or operate freely. Replace damaged material.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

C. Protect doors as recommended by door manufacturer to ensure that doors will not be damaged at time of Substantial Completion.

END OF SECTION 08 14 16

SECTION 08 31 13 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:
   1. Provide all access doors and frames for walls and ceilings as indicated in Drawings and as required for access to equipment and by authorities having jurisdiction, whether or not locations for access doors and frames are specifically indicated in Drawings.
   2. Floor access doors.

B. Related Sections include the following:
   1. Division 03 Section "Cast-in-Place Concrete" for blocking out openings for access doors and frames in concrete.
   2. Division 04 Section "Unit Masonry Assemblies".
   3. Division 05 Section "Metal Fabrications" for crawl space access ladders.
   4. Division 06 "Rough Carpentry" for coordination of wood blocking.
   5. Division 09 Section "Gypsum Board" for gypsum board assemblies.
   6. Division 09 Section "Acoustical Ceilings" for suspended acoustical tile ceilings.
   7. Division 09 Section "Wood Ceiliings" for wood ceiling lay-in access panels.
   8. Division 09 Section "Ceramic Tiling".
   9. Division 23 Section "Air Duct Accessories" for heating and air-conditioning duct access doors.

1.03 SUBMITTALS

A. Product Data: For each type of access door and frame indicated. Include construction details, fire ratings, materials, individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details of access doors and frames for each type of substrate. Include plans, elevations, sections, details, and attachments to other work.

C. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items with concealed framing, suspension systems, piping, ductwork, and other construction. Show the following:
   1. Method of attaching door frames to surrounding construction.
   2. Ceiling-mounted items including access doors and frames, lighting fixtures, diffusers, grilles, speakers, sprinklers, and special trim.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain access doors and frames of each type through one source from a single manufacturer.

B. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics per the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
   1. NFPA 252 for vertical access doors and frames.
   2. ASTM E 119 for horizontal access doors and frames.

C. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

1.05 COORDINATION

A. Verification: Coordinate with other trades to determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, electrical, or other concealed work.
   1. Size panels as required by controls to be accessed. Provide adequate sizes to service equipment accessed by doors and panels, and acceptable to authorities having jurisdiction.
   2. For replacement of access doors in existing construction, field measure to match existing opening sizes.

1.06 PRODUCT DELIVERY AND STORAGE

A. Deliver products in manufacturers original packages, clearly marked with brand name and model number.

1.07 WARRANTY

A. Manufacturer shall guarantee against defects in material and workmanship for a period of five years.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Access Doors:
      a. Acoustical Products, Inc.
      b. Acudor Products, Inc.
      c. Bilco
      d. Babcock Davis
      e. J. L. Industries, Inc.
      f. Karp Associates, Inc.
      g. Larsen's Manufacturing Company.

2.02 WALL AND CEILING ACCESS DOORS AND PANELS

A. Access Door for use in noise critical spaces: Equal to Type RDW manufactured by Karp with applied 5/8”drywall panel and factory-optional 1/16” x 3/8’ neoprene gasket.

B. Ceiling Access Door at ceilings: Access panel with 5/8” gypsum board inlay, recessed aluminum extrusion frame, concealed non corroding two point pin hinge, and cylinder lock & key, equal to Acudor Products, Inc., DW5040
   1. Size: sizes as required for intended service purpose.
   2. Fire rated to match adjacent construction when located in fire rated construction.

C. Flush Access Doors and Frames with Exposed Trim: Fabricated from steel sheet.
   1. Locations: Wall surfaces and gypsum board ceilings. Install at all location where valves or controls are concealed within walls, whether shown on the drawings or not.
   2. Door: Minimum 0.060-inch thick, 16 gauge sheet metal, set flush with exposed face flange of frame.
   3. Frame: Minimum 0.060-inch thick, 16 gauge sheet metal with nominal 1-inch-wide, surface-mounted trim.
   4. Fire rated to match adjacent construction when located in fire rated construction.

5. Hinges: Continuous piano hinge.
6. Latch: Screwdriver-operated cam latch.
7. Finish:
    a. Satin stainless steel at tile, restrooms, and other wet locations.
    b. Shop primed steel for field applied painting in other painted wall and ceiling locations. Color to match adjacent finish.

2.03 FLOOR ACCESS DOOR

A. Furnish and install, where indicated on plans, a floor access door as manufactured by Bilco Company, "Type Q". Size shall be 3' - 0" x 3' - 0" floor opening in the existing slab. The floor access door shall be single leaf, and shall be pre-assembled from the manufacturer.

B. Performance characteristics:
    1. Cover: Shall be reinforced to support a minimum live load of 150 psf with a maximum deflection of 1/150th of the span.
    2. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
    3. Operation of the cover shall not be affected by temperature.

C. Cover: Shall be 1/4” steel diamond pattern plate.

D. Frame: Shall be 1/4” steel angle with strap anchors welded to the exterior.

E. Hinges: Shall be specifically designed for horizontal installation and shall be bolted to the underside of cover.

F. Lifting mechanisms: Cam-action hinges shall pivot on torsion bars to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and to act as a check in retarding downward motion of the cover when closing.

G. A removable exterior turn/lift handle with a spring loaded ball detent shall be provided to open the cover.

H. Hardware:
    1. Hinges: Cast steel cam-action hinges which pivot on torsion bars shall be provided.
    2. Cover shall be equipped with a steel hold open arm that automatically locks the cover in the open position.
    3. Cover shall be fitted with the required number and size of torsion bars.
    4. A Type 316 stainless steel snap lock with fixed handle shall be mounted on the underside of the cover. Lock shall be keyed.
    5. Hardware: Shall be Type 316 stainless steel.

I. Finishes: Factory finish shall be alkyd based red oxide primed steel. Field paint per Division 9 Section "Painting" in color as selected by Architect.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas to receive door and frame to insure work of preceding trades is completed. Check surfaces to see that they are plumb in place, free from grease, oil or other debris which would affect proper installation. Application constitutes acceptance of substrate conditions.

3.02 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.

C. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

D. Installation: All access panel locations in Noise Critical Spaces shall be installed only where indicated on drawings. Location of additional proposed access panels shall be submitted by Contractor for approval.

E. Floor Access Door:
   1. Coordinate floor access doors installation with crawl space access ladders attachment details.
   2. Install according to floor access door manufacturer's instructions, with mechanical fasteners consistent with the manufacturer's instructions and recommendations.
   3. Install floor access door with frame flange tight to floor slab along all sides. Install floor doors before adjacent flooring is installed.

3.03 ADJUSTING AND CLEANING

A. Adjust doors and hardware after installation for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 08 31 13

SECTION 08 34 16 - STEEL SLIDING HANGAR DOORS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Furnish and install steel sliding, power operated, hangar doors and related work necessary for a complete installation as shown, specified and required for doors and controls.

B. Related Sections:
   1. Division 04 Section "Unit Masonry Assemblies."
   2. Division 05 Section "Structural Steel Framing."
   3. Division 09 Section "Painting."
   4. Division 26, for Electrical requirements, and coordination of power and controls.

1.03 PERFORMANCE REQUIREMENTS

A. Doors system designed to withstand external or internal wind loads of 30 psf, and also wind loading as required per local code requirements, whichever is greater. Maximum deflection shall not exceed l/120 of the span. Steel frames designed in accordance with AISC “Steel Construction Manual”.

B. Door system designed to withstand external or internal service level wind load of 17.1 psf.

C. Obtain doors, operators, hardware, and other accessories from a single manufacturer for sole sourced manufacturer warranty.

D. Hanger door system shall be designed within manufacturer specified tolerances for deflection.

1.04 SUBMITTALS

A. Product Data for each type of product specified, including installation instructions and data substantiating that products comply with requirements.

B. Submit detailed shop drawings of all work, including the location of each door. Clearly show and describe in detail, detailed door assemblies and adjacent construction, including elevations, sections and details of hardware, operating components, dimensions, finishes, bottom rails, top rails, wheel housings, top guide bearing assemblies, telescopic guides, cable and/or rod bracing, door locations and framing, stiles, cold form materials and mounting clips and relationship of door, frames, hardware and operating components to adjacent construction.
   1. Submit details in shop drawings shall denote weld identifications, connection hardware and drive systems.
   2. Submit wiring schematics information including field wiring, location of junction boxes, and physical locations of devices.

C. Submit design data with structural and mechanical calculations.

D. Installer’s qualifications.

1.05 CLOSEOUT SUBMITTALS

A. Submit copies of operating and maintenance data, for inclusion in maintenance manuals. Include schedule of all routine maintenance required as stipulated by warranties.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Installation work shall only be carried out by the door manufacturer or by an approved installation company properly licensed or franchised by the Manufacturer for installation work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standards and manufacturer's written instructions. Store delivered materials and equipment in dry locations with adequate ventilation and protected for dust and water.

B. Handle materials carefully to prevent damage.

1.08 WARRANTY

A. Door Manufacturer shall provide Owner a written guarantee, warranting the door against any defects of materials and/or workmanship for the new door for a period not less than two (2) years, with proper maintenance commencing from the date of a substantial completion of the project. Motors shall be guaranteed for a period of (1) one year. Manufacturer shall repair or replace defective materials during warranty period at no cost to Owner.

B. Door Installer shall provide written guarantee, warranting the door installation against defects in installation of workmanship for a period of two years from the date of substantial completion. Installer shall make all repairs required due to faulty installation, as required to restore doors and controls to perfect operating condition and to repair damage caused by faulty installation, at no cost to Owner.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Design for steel sliding doors doors are based on products as manufactured by WellBilt Industries, 1610 SW 8th Ter., Williston, FL 32696 352.528.5566. Subject to compliance with requirements, provide the named products or approved comparable products by another Manufacturer.

2.02 MATERIALS AND FABRICATION

A. Structural Steel: ASTM A36/A36M.

B. Steel Sheets: Steel sheets of commercial quality, complying with ASTM A366/A366M cold-rolled steel sheet, or A569/A569M hot-rolled steel sheet.

C. Industrial Controls and Systems: NEMA ICS 1

D. Industrial Controls and Systems Enclosures: NEMA ICS 6

E. Hardware: Manufacturer’s standard components.

F. Fasteners: Zinc-coated steel.

2.03 HORIZONTAL SLIDING HANGER DOORS

A. Basis of Design: The drawings and specifications are based on “Horizontal Sliding Hanger Doors”, as manufactured by WellBilt Industries.

B. Construction: Cold form members shall be not less than 6” and no more than 10” with a closed “C” shape. Member size shall be designed to meet the applicable wind load and spacing. Cold form shall be fastened with no less than four (4) mounting bolts per clip.

C. Hanger Door Panels:

1. All connections shall be designed to provide one hundred percent of the strength of the framing members. Stiles of the frame shall be continuous members without splices. All framing shall be square and true without warping or bending greater than 1/8" in twenty feet. Diagonal bracing shall be supplied in cable, rod, or truss design. All exposed welds shall be ground smooth and buffed.
2. Tractor pulls: Provide a tractor pull on the lead leaves of doors.
3. Track Cleaners: Provide bursh style track cleaners to the bottom of each stile.
4. Wheel and housing:
    a. Housings shall be fixed and standard design of housing shall be non-adjustable. Wheel diameter shall be biased on the weight of the system. Tread width shall conform to the rail and shall have tapered flanges with no less than 1/8" at the toe of the flange.
    b. Bottom Roller Wheels: Bottom wheel assemblies shall be manufactured from plate steel, containing a diameter capable of handling loads on door. Wheels shall be removable from the housing without requiring the removal of the door from its position on the rail. Provide grease fitting to lubricate the wheel as need.

D. Telescopic Top Guides: Provide a two-piece system to enable removal of one side for maintenance of the top guide roller bearings. Provide a minimum of two bearings per side of the housing to allow the guide assembly to roll in a straight direction. Bearings shall be angled to allow the bearing to ride flat on the top beam that has a tapper that is not able to be adjusted. The telescopic system shall be two piece inner and outer, the outer housing that thinner rides in shall be free from welds and be smooth, as telescoping portion shall be smooth and unpainted. The unpainted portion shall be lubricated and wrapped for shipping. Guide shall be hot rolled sections mounted to the support structure by welding or bolting.

E. Bottom Rail: ASCE rail shall be used per the size requirements of the panels. Unless otherwise noted, 20 lb rails shall be used. Rails to be mounted on leveling plate prior to back pour, and tack welded to ensure level installatio.

F. Provide weather stripping that is easily replaceable on the horizontal bottom and vertical edges of door. Material shall be EPDM with coth insertion and be attached 12" o.c.

G. Provide an adjustable head flashing with floating seals attached to the telescopic guides to provide a seal at the head of the door.

H. Primer: Red oxide, gray industrial primer, SSPC 25 over prepared surface.

2.04 OPERATOR

A. Basis of Design: Provide operators, door engineering and manufacturing as described in this paragraph, or approved equal by another manufacturer.

B. Electrical distribution: Provide a source of power to the leading hangar door via a trolley duct or an armored SO cable that is mounted on each door panel in a drape or buy use of festoon. If SO cable is used, provide vable pulls for each end.

C. Enclosures: Control panels shall be enclosed in NEMA 4 boxes to allow for a water tight enclosure; Installers of the electrical connections shall not drill into the top of the enclosure. All conduit runs should come from the bottom of the enclosure.

D. Contactors and Controls: Each system shall be designed for the application and size of the horizontal hanger door system. System shall included reversing contactors, operation control buttons that open, close and stop the system. System will allow for contactors to be interlocked with limit switches for opening limits and closing limits.

E. Electric motors shall be sized according to power systems requirements, and shall match the phasing of the electrical system.

2.05 OPERATION OF PANELS

A. Doors shall be Bi-Parting doors.

B. Motor Operation of Panels
   1. System shall have an operator leave on the lead door panel. Door panel shall be fitted with a traction drive bottom roller or a solid rubber tire friction operator.
      a. Traction unit shall be a double flange wheel with a direct drive sprocket attached to the wheel connected to a reversible gear reducer sized to allow the door to be opened in the event of power failure.
      b. Rubber friction operators shall be sprocket driven with a gear reducer that is not reversible and that is mounted on an adjsusting handle that maintains pressure against the floor surface. This handle shall release pressure to allow for operation in the event of power failure.

C. Operating speed: Door systems to provide for an operating range of +/- 60 lineal feet per minute.

D. Controls: Hanger doors shall be controlled by means of constant pressure push buttons mounted on a pendant mount. The control boxes shall be NEMA ICS 6 type 4 boxes.

E. Limit Switches: Door system operator shall contain control limit switches fixed to the top of the door. Limit shall be set to stop the door in the full open position as well as the closed position. Limit switches shall be wired by a certified electrician and adjusted by installer.

F. Bumpers: Top guide rail bumpers shall be supplied and fitted at the top portion of each hanger door panel to provide a permanent stopping location. Bumper shall be formed from solid rubber with a steel mounting plate welded or bolted in place.

G. Accessories
   1. Provide 1.5” wide safety edge at leading edge of door.
   2. Provide warning horn and strobe lights to notify door panel movement. Locate devices on the lead hanger door panel.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install steel sliding hangar doors in strict accordance with the approved drawings by qualified door erection crews. All door openings shall be completely prepared by the Contractor prior to the installation of the doors. Openings shall be square and plumb. Permanent electric wiring shall be brought to the door opening before installation is started and shall be completed so as not to delay the inspection test.

B. Install doors, guides, steel supports, operating hardware and electric controls. Provide required fastening devices, hangers, bolts, etc.
   1. Install units to fit into jambs and head of frames and ensure smooth operation under all conditions of operation.

C. Doors shall be set plumb, level, and square with all parts properly fastened and mounted. All moving parts shall be tested, adjusted and left in perfect operating condition.

3.02 ADJUSTING AND CLEANING

A. Inspection of the doors and a complete operating test will be made by the installer in the presence of the General Contractor and owner as soon as the erection is complete. Any defects noted shall be corrected. The General Contractor shall be responsible to protect the doors from any damage or rough handling for the remainder of the construction period until the building is turned over to the owner and final inspection is made.

B. Clean any surfaces abraded, bolts and field welds and field coat surfaces with primer.

3.03 DEMONSTRATION

A. Test and operate doors and demonstrate the operation of same to satisfaction of Owner at time of acceptance of completed work. Train owner in user-programable and safety features of the doors.

END OF SECTION 08 35 13

SECTION 08 42 29 - AUTOMATIC SLIDING DOOR

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. All labor, materials, equipment and services necessary to furnish and install new automatic sliding entrance packages and controls as indicated or specified, including final electrical connections and tune in and as required to refurbish automatic sliding entrance and controls as indicated to like new condition..

B. Related Sections include the following:
   1. Division 26 Section “Electrical”.

1.03 QUALITY ASSURANCE

A. All equipment shall comply with ANSI A-156.10.

1.04 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's specifications, recommendations and standard details for doors and frames, end tubes and headers, including fabrication, ICBO test laboratory reports as necessary to show compliance with these requirements.

B. Shop Drawings: Submit shop drawings for the fabrication and installation of door packages and associated components of the work. Include wall elevations at 1/2" scale, and full-size detail sections of every typical composite member showing integration into existing construction. Show anchors, joint system, expansion provisions, and other components not included in manufacturer's standard data. Include glazing details.

1.05 WARRANTY

A. The manufacturer shall warrant all equipment, including operators, controls, and etc.; and the installation of the equipment for a period of one (1) year from date of acceptance. The manufacturer and/or the manufacturer's distributor shall replace all defective equipment at no cost to the Owner during the one (1) year warranty period. The manufacturer shall have available on a local area level any parts and services required throughout the life of this equipment.

PART 2 - PRODUCTS

2.01 EQUIPMENT

A. Existing Automatic Door System: Replace any missing, damaged or defective parts of the door system including controls, operators, activating devices, motion detectors, etc. Utilize Besam “Power-Glide 4000”, as manufactured by ASSA ABLOY, or approved equal.

B. New Automatic Door System:
   1. Besam “Unislide” or approved equal. System shall include aluminum doors, headers, operators and controls. Sliding doors shall breakout in any point of travel and when in a "breakout" mode shall disconnect automatic operation to allow for safe egress.

a. Sliding leaf and sidelight shall have breakaway capability.
b. All decals shall conform to ANSI /A156.10 - 1985.
c. Aluminum frames and doors shall be fabricated of 6063-T5 alloy. All extruded members serving as structural support shall be of 6063-T5 alloy. I-beam header shall be capable of spanning 15'-0" without intermediate supports.
d. Door carrier(s) shall incorporate two (2) steel roller wheels per active door leaf over a replaceable Delrin track inlayed into the support beam. Incorporate two (2) anti-rise devices per leaf to prevent door derailment. Roller wheels shall be plated and incorporate double journal sealed, grease impregnated bearings. Door carriers shall permit overall lateral and vertical door adjustment of 3/4" with positive mechanical lock.
e. I-beam header shall be 8-1/8" x 6-1/4" and incorporate a continuous integral hinge for header covers. Extruded sections used for door leaf fabrication shall measure 2-1/4". Top rails shall be 2-1/2" in width for active leaf(s) and 3-13/16" for sidelite(s). All bottom rails shall be 4". All glazing to be of security type. Glass stops to be removable on interior only.

2. Sliding Door Operation:
   a. Microprocessor control, electro-mechanical operator. System shall automatically define and set the opening and closing creep positions, and the fully open and the fully closed position of the door position. Mechanical limit switches will not be accepted.
   b. The control shall include an adjustable time delay (1 to 60 seconds).
   c. Software shall incorporate a self-diagnosing system for easy serviceability.
   d. Motor shall operate from 115 VAC-60 cycle-1 phase power supply.
   e. Exterior units shall have locking mechanicsm and tie to campus remote automatic locking system.
3. Activating Devices: Software controlling presence detection shall be programmed to provide a "learn mode" so that a self-adjustment to changes in floor conditions will be made automatically.
   a. Presence Detection: Run the complete width of the door opening (max. 84") and shall extend up to 16" on either side of the active leaf. The system shall detect motionless people and/or inanimate objects. The detector shall remain energized and monitor the doorway at all times. The presence detection zone shall not be turned off before or during the door closing cycle. (No substitutions)
4. Motion Detection: Built into the Eye-Cue system shall be an adjustable infra-red motion detection field running the complete width of the doorway (max. 84") and up to 60" out from the doorway.
   a. Both presence and motion detection systems shall be capable of operation within -20 degrees F and 125 degrees F and be unaffected by ambient light, radio, or ultrasonic frequencies.
   b. The entire system to be false impulse by rain, snow, or frost and shall comply with ANSI Standard 156.10 - 1985 for detection field sizes and function. Functions shall be de-energized through the Besam position switch system when doors are not in use.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with manufacturer's specifications and recommendations for the installation of doors and frames and operators, using only factory trained personnel. Besam FTI (Field Test Instrument) must be used by installer during initial phase of the installation.

B. Set units plumb, level and true in line, without warp or rack of frames or doors. Anchor securely in place. Separate aluminum and other corrosive metal surfaces from sources of corrosion or electrolytic action at points of contact with other materials, with a bituminous coating of approximately 30 mil. dry film thickness or other suitable permanent separator.

C. The automatic door installer must examine the areas and conditions under which the automatic entrances are to be installed and notify the Contractor in writing of conditions detrimental to the proper functioning of the entrance and the timely completion of the work. Do no proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

D. The installer shall work with the Contractor to coordinate all details of the installation. Complete manufacturer's drawings and details shall be furnished for the installer of the equipment. Final connections and tune-in shall be made by the installer and the automatic entrances shall be left in a satisfactory operating condition. Factory trained personnel shall be available when required by one associated trades.

E. Set sill members and other members in a bed of compound, or with joint fillers or gaskets to provide weather-tight construction. See Division 7 Section “Joint Sealers” for compounds, fillers and gaskets to be installed integrally with doors and frames.

3.02 CLEANING

A. Clean aluminum surfaces promptly after installation of frames and doors, exercising care to avoid damage of the protective coating. Remove excess glazing and sealant compounds, dirt, and other substances.

B. Where protective coating has been damaged, remove coating completely as soon as the completion of construction activities no longer requires protection.

C. Clean and service all operational parts.

3.03 COORDINATION

A. The installer/distributor/service technician shall work with Contractor to coordinate all details pertinent to the installation of the mechanical and electrical phases as outlined by manufacturer requirements. Provide complete manufacturing drawings & details for the installation of the equipment. Final connections shall be made by the installer/distributor/service technician who will tune-in the equipment and leave it in satisfactory operating condition. The installer shall have a factory trained engineer available for job orientation when required by any of the trades.

B. Coordinate accurately and fully with other trades affected by this work.

C. Thoroughly test and check all items and equipment. Make corrections and adjustments to produce a completely satisfactory and operative installation.

END OF SECTION 08 42 29

SECTION 08 44 13 - ALUMINUM CURTAIN WALL SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Provide curtain wall system as shown on the drawings and herein specified.

B. Related Sections include the following:
   1. Division 05 Section - "Metal Fabrications".
   2. Division 06 Section - "Rough Carpentry".
   3. Division 07 Section - "Thermal Insulation".
   4. Division 07 Section - "Sheet Metal Flashing and Trim".
   5. Division 07 Section - "Joint Sealants".
   6. Division 07 Section - "Firestopping".
   7. Division 08 Section - "Door Hardware".
   8. Division 08 Section - "Glazing".

1.03 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction:
   1. Glazed aluminum curtain walls shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
   2. Dimensional tolerances of building frame and other adjacent construction.
   3. Failure includes the following:
      a. Deflection exceeding specified limits.
      b. Thermal stresses transferring to building structure.
      c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
      d. Glass breakage.
      e. Noise or vibration created by wind and by thermal and structural movements.
      f. Loosening or weakening of fasteners, attachments, and other components.
      g. Structural sealant failure, or sealant failure due to movement.
      h. Failure of operating units.

C. Structural Loads:
   1. Wind Loads: As required by authorities having jurisdiction.
   2. Other Design Loads: As indicated on Drawings.

D. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed L/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch, whichever is smaller.
    a. Operable Units: Provide a minimum 1/16 inch clearance between framing members and operable units.
3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:
    a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4-inch for spans greater than 11 feet 8-1/4 inches or 1/175 times span, for spans less than 11 feet 8-1/4 inches.

E. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:
1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.

F. Air Infiltration:
1. Fixed Framing: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft.

G. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.
1. Test Performance: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.4 at design displacement.

H. Energy Performance: Certify and label energy performance according to NFRC as follows:

1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.45 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.25 as determined according to NFRC 200.

I. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
2. Interior Ambient-Air Temperature: 75 deg F.

J. Brake Metal: Provide in thicknesses as required to prevent oil canning, including for exterior brake metal oil canning that may be caused by design wind loads. Additionally, thickness may be greater but shall not be less than minimum thicknesses as specified elsewhere in these specifications, or minimum thicknesses as indicated in Drawings. Contractor shall include necessary thicknesses in his bid.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Shop drawings and details based on the Contract Documents submitted to the Architect for review. Include plans, elevations, sections, full-size details, and attachments to other work. Show connection to and continuity with adjacent thermal, weather, and air barriers.

D. Samples for initial Selection: Manufacturer's standard color selector sheets or factory applied selector plates. Website or print media other than Manufacturer's provided materials do not represent accurate color renditions and are not acceptable.

E. Samples for verification:
   1. Submit three samples of each required aluminum finish on aluminum plates or extrusions.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.
   1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront. Compliant with local code requirements and as specified herein, whichever is more stringent.

C. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by manufacturer and witnessed by a qualified testing agency, or by a qualified testing agency.

D. Sample Warranties: For special warranties.

1.06 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.

1.07 QUALITY ASSURANCE

A. Fabricator and Installer: Shall have a minimum of 5 years experience on projects of similar size and scope. Installer shall be approved by Manufacturer.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate typical construction and waterproofing details, and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
   1. Build mockups: As part of mockup panels as detailed in drawings..
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Ordering: Comply with Manufacturer's ordering instructions and lead time requirements to avoid construction delays.

B. Packing, Shipping, Handling, and Unloading: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

C. Storage and Protection: Store materials protected from exposure to harmful weather conditions. Handle material and components to avoid damage. Protect curtain wall material against damage from elements, construction activities, and other hazards before, during and after curtain wall installation.

1.09 PROJECT CONDITIONS

A. Coordinate erection with other trades to avoid conflict. Prior to installation, verify all field measurements and job conditions. Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.10 GUARANTEE AND WARRANTY

A. Water Tightness:
   1. Installer shall submit a written guarantee to the Owner, guaranteeing storefront system for a period of 2 years against leaks and defects in the system.
   2. Provide written warranty from manufacturer that warrants glazing gaskets to be free of defects in material and workmanship for a period of five years.

B. Manufacturer's Finish Warranty: Manufacturer's standard limited warranty against fade, chalk, crack, check, peel, and failure of coatings to adhere to metal. Warranty duration as follows:
   1. Anodic Finish: 5 years from date of delivery.
   2. Fluropolymer Finish: 10 years from date of delivery.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Product: Basis-of-Design Product: Nominal 2-1/4" or 2-1/2" wide x 6" and 7-1/4" deep curtain wall glazing system, thermally broken at exterior. Subject to compliance with requirements, provide "1600 Wall System", of types as required, as manufactured by Kawneer Company, or comparable products by one of the following:
   1. EFCO Corporation.
   2. Oldcastle Building Envelope.
   3. CRL - US Aluminum.
   4. YKK AP America.

2.02 MATERIALS

A. General: Provide plates, angles, steel frame bracing, wind bracing, spacers, clips and other devices necessary to support aluminum framing and glass. Design of connections shall be fabricator's responsibility. Framing system provided with screws, miscellaneous fastening devices and internal components of non-corrosive materials. Provide all accessory metal shapes, column closures, sill caps and brake metal sections necessary for a complete installation. System provided with weeps and water stops properly draining water to the exterior.

B. Aluminum (Curtain Wall and Components):
   1. Extruded Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
   2. Member Wall Thickness: Each framing member shall have a wall thickness sufficient to meet the specified structural requirements.

3. Tolerances: Reference to tolerances for wall thickness and other cross-sectional dimensions of curtain wall members are nominal and in compliance with AA Aluminum Standards and Data.
4. Sheet and Plate: ASTM B 209.
5. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
6. Extruded Structural Pipe and Tubes: ASTM B 429.
7. Structural Profiles: ASTM B 308.

C. Internal Reinforcing:
1. ASTM A36 for carbon steel; or ASTM B308 for structural aluminum.
2. Shapes and sizes to suit installation.
3. Shop coat steel components after fabrication with alkyd type zinc chromate primer complying with FS TT-P-645.

D. Inserts and Anchorage Devices:
1. Manufacturer's standard formed or fabricated assemblies, steel or aluminum, of shapes, plates, bars or tubes.
2. Hot-dip galvanize steel assemblies after fabrication, comply with ASTM A123, 2.0 ounce minimum coating.

E. Fasteners:
1. Non-magnetic stainless steel or cadmium plated steel coated with yellow or silver iridescence plating, compatible with materials being fastened.
2. Series 300 stainless steel for exposed locations. Cadmium plated steel with 0.0005 inch plating thickness and color chromate coated for concealed locations.
3. Provide nuts or washers of design having the means to prevent disengagement; deforming of fastener threads is not acceptable.
4. Provide concealed fasteners wherever possible.
5. For exposed locations, provide countersunk flathead fasteners with finish matching item fastened.

F. Expansion Anchor Devices: Lead-shield or toothed-steel, drilled-in, expansion bolt anchors.

G. Shims: Non-staining, non-ferrous, type as recommended by system manufacturer.

H. Protective Coatings: Cold applied asphalt mastic complying with SSPC-Paint 12, compounded for 30 mil thickness for each coat; or alkyd type zinc chromate primer complying with FS TT-P-645.

I. Glazing Gaskets:
1. Compression type design, exterior replaceable, extruded EPDM. Interior is a dense EPDM closed cell EPDM sponge gasket.
2. Comply with ASTM C509 or C864.
3. Profile and hardness as necessary to maintain uniform pressure for watertight seal.
4. Manufacturer's standard black color.

J. Internal Sealants: Types recommended by system manufacturer to remain permanently non-hardening, non-migrating and weather-tight.

K. Curtain Wall Insulation and Firestopping: Refer to Division 07 Sections.

L. Glazing Accessories: Refer to Division 08 - Section "Glazing".

M. Aluminum Trim: Miscellaneous extruded and formed aluminum components shall match alloy and finish of adjacent framing members. Provide in size and shape detailed, and in thickness adequate for the intended performance.

2.03 SYSTEM FABRICATION

A. General: All curtain wall mullions, both horizontal and vertical, shall be fabricated from sections as detailed, using an anchoring system concealing all screws, clips, fasteners, etc. from the vision light area. All sections shall be fabricated true to details with clean, straight, sharply defined profiles, free from defects, in accordance with approved shop drawings and manufacturer's recommendations.
   1. Fabricate components per manufacturer's installation instructions and with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
   2. Accurately fit and secure joints and corners. Make joints flush, hairline and weatherproof.
   3. Prepare components to receive anchor devices. Fabricate anchors.
   4. Arrange fasteners and attachments to conceal from view.

B. Take accurate field measurements to verify required dimensions prior to fabrication.

C. Location of exposed joints is subject to Architect's acceptance.

D. Provide dense EPDM continuous isolator to separate exterior pressure plates and interior framing members.

E. Fabricate components in accord with approved shop drawings. Remove burrs and ease edges. Shop fabricate to greatest extent practicable to minimize field cutting, splicing, and assembly. Disassemble only to extent necessary for shipping and handling limitations.

F. Steel Components:
   1. Clean surfaces after fabrication and immediately prior to application of primer in accord with SSPC-SP2 or SSPC-SP3 at manufacturer's option.
   2. Apply specified shop coat primer in accord with manufacturer's instructions to provide 2.0 minimum dry film thickness.

G. Fabricate components true to detail and free from defects impairing appearance, strength or durability. Fabricate custom extrusions indicated and as necessary for complete installation.

H. Fabricate components to allow for accurate and rigid fit of joints and corners. Match components carefully ensuring continuity of line and design. Ensure joints and connections will be flush and weather-tight. Ensure slip joints make full, tight contact and are weather-tight.

I. Reinforce components as required at anchorage and support points, at joints, and at attachment points for interfacing work.

J. Provide structural reinforcing within framing members where required to maintain rigidity and accommodate design loads.

K. System design and sealants to accommodate internal weep and drainage system not visible to the exterior.

L. Head and sill extrusions act as gutter and weep water to exterior; do not penetrate sections with fasteners.

M. Allow for adequate clearance around perimeter of system to enable proper installation and for thermal movement within system.

N. Separate dissimilar metals with protective coating or preformed separators to prevent contact and corrosion.

O. Provide framing members to rigidly glaze spandrel panels and column covers within framing system.

P. Transom framing over entrance doors: Provide filler blocks matching curtainwall finish at connection point of removable mullions.

Q. Provide special shapes and filler pieces with tight corners.

2.04 FINISHES

A. Clear or Color Anodic Finish: AA-M12C22A31/A32/A34, AAMA 611, Architectural Class I Clear Anodic Coating.
   1. Color: Clear anodized.

B. Miscellaneous Steel Bracing (Concealed): One (1) shop coat of red oxide primer.

C. Source Quality Control: Representative samples of color anodized finish shall meet or exceed following tests: ASTM B224, thickness of coating; and ASTM B117, neutral salt spray.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Site Verification of Conditions: Verify substrate conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer's instructions. Verify openings are sized to receive curtain wall system and sill plate is level in accordance with manufacturer's acceptable tolerances.
   1. Field Measurements: Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements, fabrication schedule with construction progress to avoid construction delays.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions and applicable provisions of AAMA Aluminum Curtain Wall Design Guide Manual.

B. Align assemblies plumb and level, free of warp or twist, aligning with adjacent Work.

C. Tolerances:
   1. Limit variations from plumb and level:
      a. 1/8 inch in 20'-0" vertically and horizontally.
      b. 1/4 inch in 40'-0" either direction.
   2. Limit offsets in theoretical end-to-end and edge-to-edge alignment:
      a. 1/16 inch where surfaces are flush or less than 1/2 inch out of flush and separated by not more than 2 inches.
      b. 1/8 inch for surfaces separated by more than 2 inches.
   3. Step in face: 1/16 inch maximum.
   4. Jog in alignment: 1/16 inch maximum.
   5. Location: 1/4 inch maximum deviation of any member at any location.
   6. Tolerances are not accumulative.

D. Provide attachments and shims to permanently fasten system to building structure.

E. Anchor securely in place, allowing for required movement, including expansion and contraction.

F. Separate dissimilar materials at contract points, including metal in contact with masonry or concrete surfaces, with protective coating or preformed separators to prevent contact and electrolytic action.

G. Set sill members in bed of sealant. Set other members with internal sealants and baffles to provide weather-tight construction.

H. Water Drainage: Each light of glass shall be compartmentalized using joint plugs and silicone sealant to divert water to the horizontal weep locations. Weep holes shall be located in the horizontal pressure plates and covers to divert water to the exterior of the building.

I. Do not apply mullion covers until building is closed in, roofing is installed and no alkaline substances can be washed from building onto curtain wall system.

J. Ensure that dead-load from curtain wall system is not transferred to stone veneer.

K. Glazing:
   1. Install glazing gaskets and sealants in accordance with manufacturer's instructions without exception; including surface preparations. Refer to Division 08 - Section "Glazing" for additional requirements.
   2. Outside glazed and held in place with extruded aluminum pressure plates anchored to the mullion using Drill-Flex fasteners spaced no greater than 9” on center.

L. Curtain Wall Insulation and Firestopping:
   1. Install curtain wall insulation and firestopping specified in Division 07 Sections. Install firestopping in all locations as required by code.
   2. Install sound insulatio.

3.03 PROTECTION AND CLEANING

A. Protection: Protect installed product’s finish surfaces from damage during construction. Protect aluminum curtain wall system from damage from grinding and polishing compounds, plaster, lime, acid, cement, or other harmful contaminants.
   1. Clean materials that may damage finishes with prolonged exposure, from curtainwall surfaces immediately after spill.

B. Clean spills of sealants from framing as soon as section of framing is completed, or after completion of glass installation for the day, as applicable.

C. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer’s instructions prior to owner’s acceptance. Remove construction debris from project site and legally dispose of debris.

D. Replace broken, scratched, chipped or other damaged glazing. Remove excessive sealant, mastic and other marks from adjacent surfaces, and wash with clean water. Cleaning of framing and glazing must be done in strict compliance with manufacturer's recommendations.

END OF SECTION 08 44 13

SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY:

A. Section includes the supply and installation of the Finish Hardware.

B. Related Sections

1. Division 1
2. Openings – Division 8 / Division 8
3. Fire Alarm – Division 13/ Division 28
4. Electrical – Division 16 / Division 26
5. Security – Division 16 / Division 28

1.02 REFERENCES:

A. Documents and Institutes that shall be used in estimating, detailing and installing the items specified.

1. International Building Code – Current/Adopted Edition
2. ICC/ANSI A117.1 – Accessible and Usable Building and Facilities -
3. Current/Adopted Edition
4. NFPA80 –Standards For Fire Doors and Fire Windows – Current/Adopted Edition
5. NFPA101 – Life Safety Code – Current/Adopted Edition
6. NFPA105 – Installation of Smoke-Control Door Assemblies – Current/Adopted Edition.
7. ANSI - American National Standards Institute
8. BHMA – Builders Hardware Manufacturers Association
9. UL – Underwriters Laboratory
10. Texas Accessibility Standards – Current Adopted Edition
11. Local Building Codes

1.03 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Finish Hardware Schedule to be in vertical format to include:

1. Heading #/Hardware Set
2. Door #, Location, Hand, Degree of Opening, Door Size and Type, Frame Size and Type, Fire Rating
3. Quantity, type, style, function, product, product number, size, fasteners, finish and manufacturer of each hardware item.
4. Location of hardware set cross-referenced to indications on Drawings both on floor plans and in door and frame schedule.
5. Keying schedule
6. Title Sheet, Index, Abbreviations, Manufacturers List, Template List and Templates.
7. Mounting locations for hardware.
8. Explanation of abbreviations, symbols, and codes contained in schedule.
9. Date of the Finish Hardware Specification and Drawing / Door Schedule used in completing the Finish Hardware Schedule.

C. LEED Submittals:

1. Refer to Division 1 for any LEED submittal requirements.

D. Product Data: Provide product data in the form of a binder, manufacturer's technical product fact sheets for each item of hardware. Include whatever information may be necessary to show compliance with requirements, including instructions for installation and for maintenance of operating parts and finish.

E. Wiring Diagrams: Provide Riser/Elevation and Point to Point Wiring Diagrams for all openings with electrified hardware. Include all information that is necessary for coordination with other trades.

F. Samples: Provide samples as requested by owner or architect with Heading # and Door# marked on boxes. All samples will be returned to the contractor and used on doors for which they were marked.

G. Templates: Provide templates of finish hardware items to each fabricator of doors, frames and other work to be factory or shop prepared for the installation of hardware.

H. Keying Schedule: After meeting with the Owner, a keying schedule shall be submitted using keyset symbols referenced in DHI manual "Keying Systems and Nomenclature." The keying schedule shall be indexed by door number, keyset, hardware heading number, cross keying instructions and special key stamping instructions.

I. Operations and maintenance data: At the completion of the job, provide to the owner two copies of an Owner's operation and maintenance manual. The manual shall consist of a labeled hardcover three ring binder with the following technical information:

1. Title page containing: Project name, address and phone numbers. Supplier's name, address and phone numbers.
2. Table of Contents.
3. Copy of final Finish Hardware Schedule and Keying Schedule
4. Maintenance instruction for each item of hardware.
5. Catalog pages for each product.
6. Installation Instructions and Parts List for all Locks, Exit Devices and Door Closers.

1.04 QUALITY ASSURANCES

A. Substitutions: Request for substitutions shall not be accepted within this project. Architect, owner and Hardware Consultant have selected one (1) specified and two (2) equals listed hereinafter in the Hardware Schedule. By this selection process they have established three (3) equal products for competitive pricing, while insuring no unnecessary delays by a substitution process. If any specified product is listed as a "No Substitution" product, this product will be supplied as specified, with no alteration or request of substitution. The reason for this is to comply with the uniformity established at this project. Parts and supplies are inventoried for these particular products for ease and standardization of replacement.

B. Supplier Qualifications: Supplier shall be recognized architectural finish hardware supplier, with warehousing facilities, who have been furnishing hardware in the project vicinity for a period of not less than 2 year and who is or employs a DHI Certified AHC or person with a minimum of 10 years of experience as a hardware supplier. This person shall be available at reasonable times during the course of the work for consultation about products hardware requirements, to the owner, architect and contractor.

C. Installer Qualifications (Mechanical Hardware): All finish hardware shall be installed by the finish hardware installer with a minimum of at least two (2) years documented experience. Installer shall attend a pre-installation meeting between the contractor, finish hardware supplier, hardware manufacturer's representative for locks, closers and exit devices, all door / frame suppliers. The finish hardware installer shall be responsible for the proper installation and function of all doors and hardware.

D. Installer Qualifications (Electrified Hardware): All electrified finish hardware (power source, electrified locking or control device, switching device, through wire device and monitoring device) shall be installed by an Electronic Access Control installer licensed by the Texas Department of Public Safety. The electrified finish hardware installer shall have a minimum of at least two (2) years of documented experience. Installer shall attend a pre-installation meeting between the contractor, finish hardware supplier, electrical contractor, fire alarm contractor, security contractor, hardware manufacturers representative for locks, closers and exit devices, all door / frame suppliers. The electrified finish hardware installer shall be responsible for the proper installation, termination and function of all doors and hardware. Installation shall include termination of all electrified products (including the required wire to the power supply and/or junction box).

1.05 DELIVERY, STORAGE AND HANDLING

A. Marking and packaging: Mark each item or package separately, with identification related to hardware set number, door number and keyset symbol.

B. Delivery:

1. Deliver individually packaged and properly marked finish hardware at the proper time and location to avoid any delays in construction or installation.
2. At time of delivery, inventory hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.

C. Storage: Store hardware in enclosed, dry and locked area.

1.06 WARRANTY

A. All finish hardware products shall be covered by a 1 year factory warranty from the date of substantial completion of the project. Exit Devices shall carry a 3-year warranty, Mechanical Door Closers shall carry a 10-year warranty.

B. Supply warranty verification to the owner for all products that provide factory warranty.

1.07 MAINTENANCE:

A. Maintenance Service

1. None

B. Extra Materials:

1. All extra screws, fasteners, and all special installation tools furnished with the hardware shall be turned over to the owner at the completion of the job.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Screws and Fasteners:

1. All closers and exit devices provided for exterior doors, hollow metal doors, and all other required shall be provided with thru-bolts.
2. All finish hardware shall be installed to manufacturer's recommendations, using screws, attachments and installation tools provided with the hardware. No other screws or attachments are acceptable.
3. All other products to meet door and frame conditions.

B. Hinges:

1. Template: Provide templated units only.
2. Exterior: All exterior hinges shall be stainless steel base and finish.
3. Interior: All interior hinges steel based, satin chrome finish.

4. Interior corrosive: All interior hinges at corrosive areas shall be stainless steel base and finish.
5. Exit devices: All hinges on doors with exit devices shall be heavy weight.
6. Electric Hinge : Provide 8 wire.
7. Provide non-removable pins for outswinging doors that are locked or are lockable.
8. All hinges on doors with door closers shall be ball bearing.
9. All hinges shall be five knuckle.
10. All hinges shall be full mortise.
11. Size: Provide 4 ½ x 4 ½ hinges on doors up to 3'0" in width. Provide 5 x 4 ½ hinges on door from 3'2" to 4'0" in width. Reference manufacturers catalog for all other sizes.
12. Number of Hinges: Provide number of hinges indicated but not less than 3 hinges for door leaf for doors 90" or less in height and one additional hinge for each 30" of additional height.
13. The width of hinge shall be sufficient to clear all trim.
14. Supply from the following list of manufacturers:

Ives	IVE	www.ives.ingersollrand.com
Hager	HAG	www.hagerhinge.com
Bommer	BOM	www.bommer.com

C. Continuous Hinges
1. Continuous hinges to be manufactured of 6063-T6 aluminum alloy with anodized finish.
2. Continuous hinge to be cut in the field for power transfer.
3. Continuous hinge shall be certified to ANSI 156.25, Grade 2
4. Continuous hinge should be tested an approved UL10C.
5. Supply from the following list of manufacturers:

Ives	IVE	www.ives.ingersollrand.com
Select	SEL	www.select-hinges.com

D. Pivot Door System Hinges
1. Provide packaged system for pivot door systems"
2. Supply from basis of design manufacturer or equal.

FritsJurgens	FJN	www.fritsjurgens.com

E. Cylindrical Locks
1. All locks shall meet the new ANSI/BHMA A156.2, Series 4000, Grade 1 for key-in-lever locksets.
2. Lockset shall be UL Listed 3 hour A Label
3. Lever trim shall have individual heavy-duty compression springs behind rose for lever return and to prevent lever sag.
4. Trim shall be through-bolted with two screws coated with thread sealant.
5. Rose shall be minimum of 3 ½" diameter.
6. Lever designs shall be solid and meet ANSI A117.1.
7. Lockset shall adjust to fit door thickness from 1 ¾" to 2 1/8".
8. All locksets shall be non-handed and not require field disassembly for re-handing.
9. Supply from the following list of manufacturers:

Best	BEST	www.bestacces.com

No Substitution – Owner's Standard

F. Exit Devices

1. All exit device types on this project should be manufactured by the same manufacturer.
2. Exit devices are to be architectural grade touch bar type. Mechanism case to be smooth.
3. Exit devices shall meet ANSI A156.3, 1994, Grade 1. All exit devices are UL listed for Accident Hazard or Fire Exit Hardware.
4. All lever trim to match lock trim in design and finish.
5. Dogging: All non-rated devices are to be provided with dogging. Cylinder dogging as shown in hardware sets.
6. Exit devices are to be supplied and installed with thru-bolts for exterior, hollow metal doors, or as required for application.
7. Provide proper power supply for exit devices as required.
8. Push pads shall be metal, no plastic inserts allowed.
9. Exit devices shall have a flush end cap.
10. Exit devices shall be ordered with the correct strike for application.
11. Exit devices shall be order in the proper length to meet door width.
12. Exit devices shall have deadlatching.
13. Install exit devices with fasteners supplied by exit device manufacturer.
14. Provide glass bead kits as required.
15. Provide proper concealed vertical rods for wood or hollow metal doors as required.
16. Supply from the following manufacturer:

    Von Duprin VON www.vonduprin.com 99 Series
    No Substitution – Owner's Standard

G. Pull Plates/Pulls

1. Pull Plates to meet ANSI 156.6 for .050" thickness. Plate size to 4" x 16" with 1" round on pull plate.
2. Provide concealed fasteners for all applications.
3. Supply from the following list of manufacturers

Ives	IVE	www.ives.com
Trimco	TRI	www.trimcobbw.com
Rockwood	ROC	www.rockwoodmfg.com

H. Push Plates

1. Push Plates to meet ANSI 156.6 for .050" thickness. Plate size to be 4" x 16".
2. Supply from the following list of manufacturers

Ives	IVE	www.ives.com
Trimco	TRI	www.trimcobbw.com
Rockwood	ROC	www.rockwoodmfg.com

I. Door Closers

1. All door closers on this project should be manufactured by the same manufacturer.
2. Door closers shall meet the minimum requirements of the 1990 ADA act, in lieu of ANSI Standard A156.4 and ANSI, Grade 1 on interior fire rated openings.
3. Door closers shall be furnished with standard cover. Provide full cover as shown in hardware sets.
4. Size in accordance with the manufacturers recommendations for door size and condition.
5. Door closers shall be furnished with backcheck, delayed action, hold-open and advanced backcheck as listed in the Hardware Sets.

6. Door closers shall be mounted out of the line of sight wherever possible (i.e., room side of corridor doors, etc.) with parallel arm mounting on out swinging doors.
7. Provide and mount closer top jamb or on brackets and/or drop plates, where special conditions call for it.
8. All closer installation shall include thru bolts on exterior, hollow metal doors or where required for application.
9. Provide special template where required by application (i.e., coordinator installation).
10. Supply from the following manufacturers

LCN	LCN	www.lcnclosers.com

No Substitution – Owner's Standard

J. Door Protection Plates
1. Protective plates shall meet ANSI A156.6 requirements for .050 thickness.
2. Protection plates should be fabricated from stainless steel.
3. Kickplates shall be 10" by 2" less than door width on single door and 1" less than door width on pair of doors or as indicated in hardware sets. Beveled 4 edges.
4. Provide kickplate on all wood doors with closers, unless not required for aesthetic reasons.
5. Supply from the following list of manufacturers:

Ives	IVE	www.ives.com
Rockwood	ROC	www.rockwoodmfg.com
Trimco	TRI	www.trimcobbw.com

K. Door Stops and Holders:
1. Wall and Floor Stops: Supply wall stops where needed to protect doors or door hardware. When wall conditions do not permit use of wall stop provide floor stops with risers as needed to adjust for floor conditions.
2. Where Wall Stops are used, install so lock does not lock unintentionally.
3. Overhead Stops: Where wall or floors stops are not applicable provide concealed or surface overhead stops.
4. Exterior Stops: Provide security floor stop.
5. Supply from the following list of manufacturers:

Ives	IVE	www.ives.com
Glynn Johnson	GLY	www.glynn-johnson.com
Trimco	TRI	www.trimcobbw.com

L. Silencers
1. Provide silencers on all doors without seal. 3 for single doors and 2 for pairs.
2. Provide silencers as required for frame conditions. SR64 for hollow metal frames. SR65 for wood frames.
3. Supply from the following list of manufacturer's

Ives	IVE	www.ives.com
Rockwood	ROC	www.rockwoodmfg.com
Trimco	TRI	www.trimcobbw.com

M. Thresholds/Weatherstripping
1. All thresholds shall conform to state and local handicap codes.
2. Smoke seal shall be teardrop design bulb seal.
3. Exterior seal/thresholds shall be silicone or brush as shown in hardware sets.
4. Sound seal shall be silicone.
5. Drip strips shall protrude 2 ½" and be 4" wider than opening.
6. Provide door sweeps.

7. Provide UL meeting stile gasketing for fire rated doors.
8. Supply from the following list of manufacturer's

Zero	ZER	www.zerointernational.com
National Guard	NGP	www.ngpinc.com
Hager Hinge Company	HAG	www.hagerhinge.com
Pemko	PEM	www.pemko.com

2.03 KEYING:

A. General: Finish Hardware Supplier shall meet in person with owner to finalize keying requirements prior to the locks and exit devices being ordered and match existing or start a new Restricted Master Key System for the project. During keying meeting all hardware functions should be reviewed with the owner to finalize lock and exit device functions.
B. Cylinders: All cylinder/cores on this project should be manufactured and providing in the same keyway.
C. Cylinders: Provide the correct and quantity of cylinders for all applications.
D. Keys: Provide nickel silver keys only. Furnish 2 change keys for each lock: 5 control keys: 5 master keys for each master system and 5 grandmaster keys for each grandmaster key system. Deliver all keys to owners' representative.
E. BEst Cores and keys shall be provided with identification stamping.
F. Provide construction keying / construction cores for this project with constructions keys.
G. Supply from the following manufacturer:
   Best, Match existing system
   No Substitution – Owner's Standard

2.04 KEY CONTROL:

A. Key Management: Prior to release of orders to the lockset manufacturer, meet with the UT Arlington Lock Shop to review the keying requirements.

PART 3 – EXECUTION:

3.01 EXAMINATION:

A. Examine doors, frames and related items for conditions that would prevent the proper application of any finish hardware items. Do not proceed with installation until all defects are corrected.

3.02 INSTALLATION:

A. Follow Door and Hardware Institute Publication for:
   Recommended Location for Architectural Hardware for Standard Steel Doors and Frames
   Recommended Location for Builder's Hardware for Custom Steel Doors and Frames
   Recommended Locations for Architectural Hardware for Wood Flush Door
B. Follow ANSI A117.1-1998 Accessible and Usable Building and Facilities
C. Review mounting locations with Architect.
D. Pre Installation meeting required with attendees to include Architect, Contractor, Mechanical Hardware and Electrified Hardware Installer, Finish Hardware Supplier and Manufacturer's Representative for Exit Device, Locks and Closers before installation begins.

3.03 FIELD QUALITY CONTROL:

A. After installation has been completed, obtain the services of an Architectural Hardware Consultant to check for proper installation of finish hardware, according to the finish hardware schedule and keying schedule. In addition, check all hardware for adjustments and proper operation.

3.04 ADJUST AND CLEAN:

A. Adjust, clean and inspect all hardware, to ensure proper operation and function of every opening. Replace items, which cannot be adjusted to operate freely and smoothly as intended for the application made.

3.05 PROTECTION:

A. The general contractor shall use all means at his disposal to protect all finish hardware items from abuse, corrosion and other damage until the owner accepts the project as complete.

3.07 TRAINING

A. After installation has been completed, provide training to the Owner on the operation of finish hardware and programming of any access control items.

3.06 HARDWARE SCHEDULE

A. These hardware set shown below are for use as a guideline. Provide hardware as required to meet the requirements of the openings, security, and code requirements.

HARDWARE GROUP NO. 801

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PANIC HARDWARE	9947-EO-LBR (WDC @ WD) LENGTH & HEIGHT AS REQUIRED	626	VON
1	EA	PANIC HARDWARE	9947-NL-OP-LBR (WDC @ WD) LENGTH & HEIGHT AS REQUIRED	626	VON
1	EA	RIM CYLINDER	MATCH EXISTING	626	
1	EA	CORE	MATCH EXISTING	626	
1	EA	LONG DOOR PULL	9266F 36” 20” STD	630	IVE
2	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ X ST3596	689	LCN
2	EA	PROTECTION PLATE	8400 10" X 1" LDW B-CS	630	IVE
2	EA	WALL STOP HOLDER	WS45	630	IVE
2	EA	GASKETING	188S PSA H& J	BK	ZER
2	EA	DOOR BOTTOM	369AA-Z49 LENGTH AS REQ.	AA	ZER

HARDWARE GROUP NO. 802

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	PIVOT HINGE	M32E		FJN
1	EA	LONG DOOR PULL	9266F 36” 20” STD	626	BEST
1	EA	NOTE	REMAINING HARDWARE BY DOOR MFG.		

HARDWARE GROUP NO. D001

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CYLINDER	MORTISE CYLINDER X TYPE AS REQ.		BEST
1	EA	LFIC CORE	BEST PREMIUM	626	BEST
1	EA	DOOR CONTACT	679-05 TYPE AS REQ	WHT	SCE
1	EA	NOTE	REMAINING HARDWARE BY DOOR MFG.		

END OF SECTION 08 71 00

SECTION 08 80 00 - GLAZING

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. Provide all glass and glazing as shown on the drawings and as herein specified.

B. Related Sections include the following:
   1. Division 5 Section "Miscellaneous Metals."
   2. Division 8 Section "Aluminum Curtain Wall System."
   3. Division 8 Section "Wood Doors."

1.03 DEFINITIONS

A. Interspace: Space between lites of any insulating glass unit that contains dehydrated air or a specified gas.

B. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking and other indications of deterioration in metallic coating.

C. Deterioration of Insulating Glass: Failure of the hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for 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.

D. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination material obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standards.

1.04 DESIGN REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movements, wind and impact loads without failure, including loss or glass breakage due to defective manufacture, fabrication, and installation, deterioration of glazing materials and other defects in construction.

B. Glass Design: Provide glass lites in the thickness and strengths (annealed or heat-treated) to meet or exceed the following criteria based on analysis of Project loads and in-service conditions.
   1. Minimum glass thickness of lites composed of annealed or heat-treated glass are selected so the worst-case probability of failure does not exceed the following:
      a. Eight (8) lites per 1000 for lites set vertically or not over 15 degrees off vertical and under wind action.

b. One (1) lite per 1000 for lites set over 15 degrees off vertical and under action of wind or snow.
c. Specified Design Wind Loads: As indicated on the Structural Drawings
d. Specified Design Snow Loads: As indicated on the Structural Drawings, but not less than snow loads applicable to Project, required by ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 7, "Snow Loads.
e. Minimum Glass Thickness for Exterior Lites: Not less than 6mm
f. Thickness of Tinted and Heat-Absorbing glass: Provide the same thickness of each tint color indicated throughout Project.

C. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:
1. Center-of-glass U-values: NFRC 100 methodology using LBL-35298 WINDOW 5.2 computer program, expressed as BTU/sq ft x h x deg F (W/sq. m x K).
2. Center-of-glass solar heat gain coefficient: NFRC 200 methodology using LBL-35298 WINDOW 5.2 computer program
3. Solar Optical Properties: NFRC 300.

1.05 QUALITY ASSURANCE

A. Design Criteria: Glass shall conform to Fed. Spec. DD-G-001403.

B. Installation Criteria: FGJA "Glazing Manual".

C. Security Glazing: Applicable standards
1. Consumer Product Safety Standard 16 CFR 1201, Category II
2. ANSI Z97.1, Safety Glazing Materials Used in Buildings
3. ASTM C1036, Flat Glass
4. ASTM C1172, Laminated Architectural Flat Glass
5. ASTM C1048, Heat-Treated Flat Glass
6. Fed. Spec. MIL-P-46144, Polycarbonate Plastic Sheet.

D. Comply with published recommendations of glass product manufacturers and organizations below, except where more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this section or in referenced standards.
1. GANA Publications
a. GANA Glazing Manual
b. Tempering Division - Engineering Standards Manual
2. LSGA Publications

E. Safety glass products are to comply with ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for Category II materials.
1. Subject to compliance with requirements, provide safety glass permanently marked with certification label of Safety Glazing Certification Council (SGCC) or other certification agency acceptable to authorities having jurisdiction.

F. Insulating glass products are to be permanently marked either on spacers or at least one component lite of units with appropriate certification label of inspecting and testing agency indicated below:
1. Insulating Glass Certification Council (IGCC).

G. Single Source fabrication responsibility: Fabrication processes, including Low E and reflective coatings, insulating, laminating, silkscreen, and tempering, shall be fabricated by a single Fabricator.

H. Glass fabricator to have 10 years of experience and meet ANSI / ASQC Q9002 1994.

I. Mockups: Before glazing, build mockups for each glass product indicated below to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups using materials indicated for the completed work.

1.06 SUBMITTALS

A. Submit 12-inch square samples of each type of glass indicated except for clear monolithic glass products, and 12-inch long samples of each color required (except black) for each type of sealant or gasket exposed to view.

B. Glazing contractor to obtain compatibility and adhesion test reports from sealant manufacturer indicating that glazing materials were tested for compatibility and adhesion with glazing sealants and other glazing materials.

C. Product Certificates: Obtain Certificate of Compliance for all glass products

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun or other causes.

1.08 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by the glazing material manufacturers and when glazing channel substrates are wet from rain, frost condensation, or other causes.
   1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F (4.4 deg C)

1.09 WARRANTY

A. Provide a written 10-year warranty from date of manufacture for coated glass. Warranty covers deterioration due to normal conditions of use and not to handling, installing, and cleaning practices contrary to the glass manufacturer's published instructions.

B. Provide a written 10-year warranty (vertical application) from date of manufacture for insulating glass. Warranty covers deterioration due to normal conditions of use and not to handling, installing, protecting, and maintaining practices contrary to glass manufacturer's published instructions.

C. Provide a written 5-year warranty from date of manufacture for ceramic frit. Warranty covers deterioration due to normal conditions of use and not to handling, installing, and cleaning practices contrary to the glass manufacturer's published instructions.

PART 2 - PRODUCTS

2.01 BASIS OF DESIGN

A. Available Products: Basis of Design products are indicated in the Glass Types later in this section. Provide Basis of Design products, or equal as approved by Architect.

2.02 GLASS PRODUCTS

A. Float Glass
   1. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

2. Heat-strengthened float glass: ASTM C 1048.
    a. Kind HS heat-treated glass
3. Fully tempered float glass: ASTM C 1048.
    a. Kind fully tempered (FT)

B. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
1. ASTM E773 Seal Durability of Sealed Insulating Glass Units
2. ASTM E774 Sealed Insulating Glass Units
3. Sealed insulating glass units to be double sealed with a primary seal of black (or gray) polyisobutylene and a secondary seal of black (or gray) silicone.
4. Lites shall be separated by an aluminum spacer with 3 bent corners and 1 keyed-soldered corner, or 4 bent corners and a straight butyl injected zinc plated steel straight key joint, to provide a hermetically sealed and dehydrated air space.
5. Units shall be certified for compliance with seal classification "CBA" by the Insulating Glass Certification Council (IGCC) and tested in accordance with the above ASTM Test Methods.

C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
1. For monolithic-glass lites, properties are based on units with lites.
2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
3. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg .
4. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBNL WINDOW 6 computer program.
5. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

D. Glass Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.
1. Clear Glass: Mirror Select Quality

2.03 MATERIALS

A. Provide fully-tempered glazing at impact locations, per applicable codes.

B. Glass Types:
1. Type 2: 1/4" Clear float, tempered (at interior storefront system).
2. Type 3A: 1" Insulated, tempered; PPG Ideascapes Solarban "90" (2) Clear + Clear Glass (Low-E).
    a. Visible Light Transmittance: 51%.
    b. Winter Nightime U – Value: .29
    c. Solar Heat Gain Coefficient: .23

2.04 MISCELLANEOUS GLAZING MATERIALS

A. Select glazing sealants, tapes, gaskets and other glazing materials of proven compatibility with other materials they will contact, including glass products, seals of insulating glass units and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.

2.05 MISCELLANEOUS MIRROR MATERIALS

A. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both mirror manufacturer and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.
   1. Adhesive shall have a VOC content of not more than 70 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Mounting Accessories: Brushed stainless steel (Type 302) mirror clips similar to KV277 at bottom and KV278 at top in number as required to accommodate size of mirror.

PART 3 - EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Carefully inspect and verify all job site conditions and measurements.

B. Clean all surfaces of all glazing units and materials to which glazing compound and/or tapes shall be applied and prime as recommended by compound and/or tape manufacturer's instructions.

C. Verify prepared openings for glazing are correctly sized and within tolerance.

D. Verify that a functioning weep system is present.

E. Verify that the minimum required face and edge clearances are being followed.

F. Do not proceed with glazing until unsatisfactory conditions have been corrected.

G. Clean glazing channels and other framing members receiving glass immediately before glazing remove coatings not firmly bonded to substrates.

3.02 GLAZING

A. Install products using the recommendations of manufacturers of glass, sealants, gaskets, and other glazing materials except where more stringent requirements are indicated, including those in "GANA Glazing Manual".

B. Glazing to fit line in rabbet with all edges straight and true. Size substantially as shown on the drawings, however Contractor shall fill sash and openings as actually constructed whether more or less than sizes given.

C. Material installed in a full bed of sealant, tooling finished surfaces smooth.

D. Mirrors installed using mirror glazing angles, concealed clips and mirror setting mastic. Mastic applied on substrate in spot application, spacing and sizes as recommended by mirror manufacturer for use intended.

3.03 ADJUST AND CLEAN

A. Clean excess sealant or compound from glass and framing members immediately after application, using solvents or cleaners recommended by manufacturers.

B. Glazing shall be protected from damage during construction. Contractor shall assume all responsibility for breakage and shall replace cracked, broken, scratched or otherwise defective glazing.

C. Glazing shall be cleaned carefully at time of final acceptance, removing all labels, excess sealant, paint and other foreign substances.

END OF SECTION 08 80 00

SECTION 09 21 00 - GYPSUM BOARD ASSEMBLIES

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. Provide gypsum drywall as shown on the drawings and as herein specified including but not limited to: Metal stud framing, suspended ceiling systems, gypsum drywall and finishing systems.

B. Related Sections include the following:
   1. Division 5 Section “Cold Formed Metal Framing.”
   2. Division 6 Section “Rough Carpentry.”
   3. Division 6 Section “Architectural Woodwork", for coordination of metal framed cabinet supports.
   4. Division 7 Section “Thermal Insulation.”
   5. Division 7 for additional requirements for fire stopping and sealants installed with gypsum board assemblies.
   6. Division 9 Section “Metal Support Systems.”
   7. Division 9 Section “Acoustical Insulation.”
   8. Division 9 Section “Painting.”
   9. Division 9 Sections, for coordination of tiling, wall base materials, and other finishes applied to gypsum board assemblies.
   10. Divisions 10 and 11, and other Sections as applicable, for coordination of accessories and equipment requiring blocking in walls.

1.03 SUBMITTALS

A. Certificate: Furnish certificate evidencing that material meets or exceeds specification and fire rating requirement.

B. Samples: Approximately 12" square for each interior paint color indicated. Provide approximate 1" stepped application along one edge to demonstrate each layer.

C. Informational Submittals:
   1. Research/Evaluation Reports: Evidence of cold-formed metal framing's compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
      a. Evaluation reports certified under an independent third party inspection program administered by an agency accredited by IAS to ICC-ES AC98, IAS Accreditation Criteria for Inspection Agencies.

1.04 QUALITY ASSURANCE

A. Metal Support Standard: ASTM C754.

B. Metal Stud Standard: Fed Spec QQS-698 and QQS-775d, Class D.

C. Gypsum Board Standard: GA 216 by Gypsum Association.

D. Tolerances: 1/8" Offsets between planes of board faces and 1/4" in 8'-0" for plumb, level, warp and bow.

E. Gypsum Board Finish Mockups: Before finishing gypsum board assemblies, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and qualities of materials and execution.
   1. Install mockups for the following applications:
      a. Surfaces indicated to receive nontextured paint finishes.
   2. Simulate finished lighting conditions for review of mockups.
   3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.05 PERFORMANCE / DESIGN CRITERIA

A. Acoustic Ratings: Construct assemblies to achieve acoustic ratings indicated on Drawings, assemblies tested to ASTM E90 and classified in accordance with ASTM E 413 by an independent testing agency.

B. Deflection Limits:
   1. Limit deflection of partitions to following limits, based on design load.
      a. Partitions to receive tile, plaster, adhered stone, or similar heavy finish materials: L/240
      b. Other partitions: L/240.
      c. Comply with minimum stud gauges required elsewhere in these specifications, the most stringent requirement shall prevail. If partition height exceeds stud manufacturer's limiting height for applicable loading and deflection, install bracing above ceiling, decrease stud spacing, or increase stud gauge.
      d. Limit deflection of ceilings to L/360

C. 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, and displaying a classification label from, an independent testing agency acceptable to the authority having jurisdiction.
   1. Fire-Resistance-Rated Assemblies: Indicated by design designations from GA-600, "Fire Resistance Design Manual."
   2. Construct assemblies to achieve fire resistance ratings indicated on Drawings, in accordance with applicable UL design numbers.
   3. In the event that requirements of assembly numbers referenced conflict with other Contract Document requirements, conform to assembly requirements.

D. Low-Emitting Materials: For ceiling and wall assemblies, provide materials and construction identical to those tested in assembly and complying with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials with manufacturer's label attached. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging. Protect materials from dampness or wetting. Remove any damaged materials.

B. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI's "Code of Standard Practice".

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
   1. Steel Framing and Furring:
      a. Allied Building Products, Inc.
      b. AllSteel Products, Inc.
      c. Cemco.
      d. Clark-Dietrich Building Systems.
      e. Consolidated Fabricators Corp.
      f. MarinoWare; Div. of Ware Industries, Inc.
      g. MBA Building Supplies.
      h. Scafco Corp.
      i. United Metal Products, Inc.
   2. Gypsum Board and Related Products:
      a. G-P Gypsum Corp.
      b. National Gypsum Company.
      c. United States Gypsum Co. (USG)

B. Source Limitations:
   1. Provide framing materials and accessories used on the project by one manufacturer throughout.

2.02 FRAMING MATERIALS AND ACCESSORIES

A. Components, General: As follows:
   1. Comply with ASTM C 754 for conditions indicated.
   2. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with ASTM A 653/A 653M, G40, hot-dip galvanized zinc coating.

B. Metal Framing: Provide light gauge metal framing and accessories supplied by one manufacturer throughout. Provide standard gauges of galvanized steel channel studs at size and spacings indicated on drawings, and as follows:
   1. Minimum 18 gauge studs where distance between horizontal bracing is greater than 12'-0".
   2. Minimum 16 gauge studs where distance between horizontal bracing is greater than 18'-0".
   3. Minimum 20 gauge studs where greater gauge is not otherwise required.
   4. Depths: As indicated in Drawings

C. Runner Tracks: ASTM C645. Standard with manufacturer for type and size stud utilized, same finish. Furnish all necessary miscellaneous accessories such as clips, brackets, etc.

D. Deflection Track: Manufacturer's standard deep leg track. Utilize Firestop track at fire rated walls as tested in U. L. assemblies for head of wall joint.

E. Stud Spacer bars: 7/8" x 7/8" x 50" long right angle bar pre-notched 12", 16", and 24" centers. (20 gauge.)

F. Gypsum Board Ceiling Cold Rolled Main Runner Carrying Channels: 1-1/2", 16 gauge steel channels with minimum 1/2" wide flanges.

G. Cold Rolled Furring Channels: Depths as indicated on Drawings, 16 gauge steel channels with minimum 1/2" wide flanges.

H. Hat Shape Furring Channels: ASTM C 645, 7/8" x 1-1/4", minimum 22 gauge, galvanized steel hat shaped sections.

I. Resilient Furring Channels: 1/2" deep steel sheet members designed to reduce sound transmission.
   1. Configuration: Hat shaped.

J. Z-Shaped Furring Channels: With slotted or non-slotted web, face flange of 1-1/4", and wall attachment flange of 7/8". Minimum 20 gauge galvanized steel, or heavier where required by weight of and deflection limits for attached finish systems. Size: as indicated in Drawings .
   1. Provide J or C shaped track and channels with non-slotted web to frame around openings where required and where indicated in Drawings for fire rated construction and / or for screw attachment or support of windows. 16 gauge where required to prevent flame spread at cavity wall construction.

K. Slide Clips: Provide minimum 600 pound lateral capacity design load thickness, or as shown on drawings. Provide prefabricated clips as manufactured by Clark Dietrich Framing Systems, or equal. Install as shown on drawings.

L. Framed openings: Galvanized steel one piece header and jamb studs meeting or exceeding the requirements of ASTM C 754.

M. Blocking and Backing Plates: Refer to Division 06, Section "Rough Carpentry**".** At Contractor's option, the following blocking types may be provided in lieu of fire rated wood blocking, provided that the material will meet the most stringent strength requirements for each item to be attached to such blocking.
   1. Minimum 16 gauge, galvanized sheet steel backing plates.

N. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

2.03 GYPSUM WALLBOARD PANELS

A. General: Specifications based on materials and manufacturers listed are to set quality standard. Subject to compliance with requirements, provide the named products, or comparable products by another manufacturer.

B. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

C. Gypsum Wallboard: ASTM C 1396 unless otherwise indicated.
   1. Type X:
      a. Thickness: 5/8" .
      b. Long Edges: Tapered.
      c. Location: Typical where other wallboard type is not otherwise indicated.
   2. Type C:
      a. Thickness: 5/8" .

b. Long Edges: Tapered.
c. Location: Fire rated ceilings.

3. Impact-Resistant Gypsum Board: ASTM C 1629.
   a. Core: 5/8" Type X.
   b. Surface Abrasion: Meets or exceeds Level 2 requirements.
   c. Surface Indentation: Meets or exceeds Level 2 requirements.
   d. Single-Drop Soft-Body Impact: Meets or exceeds Level 2 requirements.
   e. Hard-Body Impact: Meets or exceeds Level 2 requirements according to test in Annex A1.
   f. Long Edges: Tapered.
   g. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
   h. Locations: Where indicated .

D. Exterior Sheathing: Provide sheathing types as follows:
   1. Cellulose Fiber-Reinforced Gypsum Sheathing Board: ASTM C 1278/C 1278M, 1/2" thick gypsum sheathing, with manufacturer's standard edges.
   2. Glass-Mat Gypsum Sheathing Board: ASTM C 1177, 1/2" thick gypsum sheathing, with fiberglass mat laminated to both sides and with manufacturer's standard edges, equal to "Dens-Glass Gold" by G-P Gypsum.

2.04 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.
   1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
   2. Shapes:
      a. Cornerbeads: Equal to USG Dur-A-Bead. Use at outside corners.
      b. Metal Edge Trim: Standard trim of galvanized steel with either knurled and perforated or expanded flanges and beaded for concealment of flange in joint compound. Equal to USG 200 or 400 Series. Apply where board abuts or terminates at another material.
         1) L-Bead: L-shaped; exposed long flange receives joint compound; use at exposed panel edges.
         2) J-Mold: Metal J-molds; exposed flange receives joint compound, use at all panel edges abutting dissimilar materials.
      c. Gypsum Control Joints: Metal V-shape control joints. Use where indicated and at changes in backup material and in partitions at 30’-0” o.c. maximum, and at large gypsum board ceiling areas at 20'-0" o.c. maximum. Also provide at both sides all interior and exterior window & door frames.

2.05 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475.

B. Joint Tape:
   1. Interior Gypsum Wallboard: Paper.
   2. Tile Backing Panels: As recommended by panel manufacturer.
      a. Use polymer-coated (alkali-resistant) mesh tape, 2” wide at interior applications, and 3” wide at exterior applications.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
   1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound, equal to USG Durabond 90.

2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound, equal to USG Durabond Joint Taping Compound.
3. Fill Coat: For second coat, use drying-type, all-purpose compound, equal to USG Ready Mixed Joint Topping.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.

D. Joint Compound for Tile Backing Panels:
1. Cementitious Backer Units: As recommended by panel manufacturer.

2.06 ACOUSTICAL SEALANT

A. Products: Subject to compliance with requirements, manufacturers offering products which may be incorporated into the work include the following:
1. Acoustical Sealant for Exposed and Concealed Joints:
a. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.
2. Acoustical foam sealant may be used to fill voids to decking or other similar conditions above ceilings.

B. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant**,** complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

2.07 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
1. Laminating adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Door frame Grout: Equal to USG Durabond 90 Joint Compound, Multi-Purpose.

D. Sealer Gaskets: 5-12" x 3/8" closed cell foam and adhesive backed peel and stick membrane, equal to Protecto Wrap (800-759-9727) "Triple Guard Energy Sill Sealer." Provide at all exterior metal studs in contact with floor slab.

E. Hanger Wire: ASTM A 641, 9 Gauge galvanized steel wire.

F. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

G. Insulation:
1. Thermal Insulation: Refer to Division 07, Section "Thermal Insulation".
2. Acoustical Insulation: Refer to Division 09, Section "Acoustical Insulation".
3. Fire Resistant Assemblies: Provide mineral fiber insulation according to the requirements of the fire rated assembly, except where greater thickness is indicated for partitions that also carry an acoustical rating.

PART 3 - EXECUTION

3.01 EXAMINATION AND COORDINATION

A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Interface and Coordination with Other Work:
   1. Coordinate installation of firestopping at penetrations through fire-resistive rated assemblies.
   2. Coordinate installation of joint sealers specified in Division 7 Section at penetrations of non fire-resistive rated assemblies.
   3. Coordinate support framing and blocking requirements of all construction to be attached to gypsum board assemblies.
   4. At partitions indicated to receive thermal or acoustical batts, pack insulation into cavities while framing is being fabricated for stud packs, box headers, and other framing cavities that will be inaccessible upon erection of framing.
   5. Coordinate installation with joints in adjacent construction designed to reduce transmission of sound. Do not install gypsum board assemblies in a manner to create an acoustical bridge across such joints and conditions. Conditions include but are not limited to the following:
      a. Floor and slab acoustical isolation and similar construction details.
      b. Acoustical isolation of structural members and components.
      c. Mechanical ductwork acoustical joints and construction.
   6. 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.
      a. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

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

3.02 INSTALLATION - METAL FRAMING

A. General Installation Standard: ASTM C 754.
   1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
   2. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.
   3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.
   4. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.

B. Fire rated wall partitions installed to provide specified design criteria requirements. Partitions continuous from floor level to underside of structure and completely fire taped.

C. Stud and Framing Installation:
   1. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
   2. Steel studs cut to proper length, plumbed and aligned, continuous runner tracks attached to structure at intervals not to exceed stud spacing specified. Anchor all exterior studs

and studs adjacent to window and door frames, partition intersections and corners to runner flanges.

3. Studs for partitions indicated to be fire rated or to include sound batts shall extend to deck, unless noted otherwise.
4. Where partitions abut ceiling or deck construction or vertical structural elements, provide slip or cushion type joint between partition and structure as recommended by stud manufacturer.
5. Install double studs at all jambs, and at head conditions not requiring box beams, at all windows & doors.
6. Install supplementary framing as necessary to support fixtures, equipment services, grab bars, toilet accessories, furnishings, or similar construction. Install, or coordinate installation of wood blocking by other trade as applicable, for all such construction.
7. Install bracing at terminations in assemblies.
8. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.
9. At jambs and heads of openings in fire rated cavity walls, install 16 gauge C or J shaped perimeter framing or tracks of solid profile without cut-outs, where required for flame spread prevention into cavity. Framing sized to fill space from face of sheathing to back side of loose lintel, masonry veneer, or other non-combustible finish material.

D. Fastenings for Wall Supported Items: Provide and install 12 gauge wall reinforcing plates 6" high (minimum) x 1 stud space wide or 2 x 8 (minimum) x 1 stud space fire retardant wood blocking, unless specified otherwise at all stud wall areas receiving grab bars, toilet partitions, wall bumpers and other wall mounted accessories. Plates welded or screwed to studs.

3.03 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
   1. Main runner carrying channels attached to structure with hangar spacing as required to meet requirements of ASTM C 754, and other criteria as specified. Cross furring 3/4" channels attached to main runners.
   2. Deflection limited to 1/360 of span.
   3. Maximum allowable spacing of main runners, 48" O.C.; and cross furring 24" maximum O.C. At openings which interrupt main runners or furring channels, reinforce grille with 3/4" channels wire tied to and parallel to main runner channels.
   4. Maximum allowable spacing of hangers 48" O.C.
   5. Install uplift bracing to structure at exterior locations, air lock vestibules, and at other spaces subject to wind uplift or sudden changes in air pressure.
   6. Install bracing to structure at 8'-0" on center each way in as noted on drawings.

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.
   2. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
   3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with 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 unless more stringent requirements are specified.

4. 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.
5. 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.
6. Do not attach hangers to steel roof deck.
7. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
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. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.04 INSTALLATION - PANEL ERECTION

A. General: Comply with ASTM C840.

B. Panel Installation:
1. Use wallboard and sheathing of maximum lengths to minimize joints.
2. Stagger end joints where they occur.
3. Stagger vertical joints on opposite sides of partitions, and stagger joints between each layer of panel in multiple layer installations, by at least one framing member.
   a. Exception: Do not bridge panels over expansion joints.
4. Locate end joints as far as possible from center of wall or ceiling.
5. Do not place butt ends against tapered or grooved edges. Do not place tapered edges against cut edges or ends.
6. Support ends and edges of wallboard on framing or furring members.
7. No wallboard installed over piping, ducts, electric boxes or conduits until they have been installed, run and tested.
8. Attach wallboard and sheathing with screws spaced 12" O.C. and staggered along abutting vertical edges.
9. Exterior grooved sheathing installed horizontally with tongue up.
10. Partitions indicated sealed to deck shall be continuous except where interrupted by structure, mechanical or electrical construction.
11. Fit gypsum panels around ducts, pipes, conduits, and structural members. Cut panels to fit profile of penetrations and apply a bead of sealant 1/4" to 3/8" wide.
12. Tape and float only is acceptable behind lockers that have solid backs unless otherwise required for partition fire or acoustical ratings.
13. Rated partitions shall have wall board continuous both sides above ceiling to deck and fire taped and sealed.
14. Partitions shown to include sound batt but not to extend to deck shall have wall board continuous to deck above ceiling and taped on one side only.
    a. Exception: Partitions shown to have acoustical insulation placed over ceiling to either side of the partition wall.
15. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, including floors and deck. Provide 1/4- to 1/2-inch wide spaces at these

locations. Trim edges with edge trim where edges of panels will be exposed in the completed work. Seal joints between edges and abutting structural surfaces with acoustical sealant

16. Form control and expansion joints with space between edges of adjoining panels.
17. Refer to Division 07, Section "Expansion Control" for installation of expansion control joints and expansion joint covers located within or adjacent to gypsum board assemblies.

C. Exterior Sheathing: Install grooved boards horizontally with tongue up.

D. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
   1. .

E. Accessory Installation:
   1. Corner Beads: Install on external corners with suitable fasteners spaced 9" O.C.
   2. Metal Trim: Install over face layer with fasteners spaced 9" O.C. where shown and where gypsum surfaces meet dissimilar materials.
   3. Control Joint: Install control joints in locations where detailed, and the following, unless otherwise indicated:
      a. At changes in backup material.
      b. Vertically in partition walls at 30'-0" maximum on center.
      c. Horizontally in partition walls taller than 16' . Confirm elevations of such joints with Architect.
      d. In large ceilings 20'-0" maximum on center each way.

      e. At interior side of all exterior door and window frames.
      f. At both sides of all interior and exterior door and window frames.
   4. Aluminum Trim: Install in locations indicated in Drawings.

F. Joint Treatment Application:
   1. Joint treatment compounds and products, as specified under Materials, shall be mixed and applied in accordance with manufacturer's direction to completely conceal all joints and screw depressions and provide a smooth surface to receive finishes as scheduled.

3.05 FINISH

A. Apply gypsum board finish in accordance with ASTM C 840, manufacturer's published instructions and GA-214 Finish Levels.
   1. Level 1: All joints and interior angles shall have tape embedded in joint compound. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable.
      a. Application: In plenum areas above ceilings, in attics, in mechanical rooms, and in other areas where the assembly is generally concealed and not normally open to view. Accessories not required unless otherwise indicated or required by fire rated or acoustical rated construction.
         1) Where a fire resistance rating is required for the gypsum board assembly, details of construction shall be in accordance with reports of fire tests of assemblies that have met the fire rating requirement.
         2) Where acoustical rating requires more stringent finish application, comply with acoustical partition construction requirements.

2. Level 2: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges and sand joints. Provide level 2 finish where panels are substrate for tile, behind plywood backer boards, in mechanical and electrical rooms and where specifically indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.

Coordinate finish with texture requirements, level 5 finish specified below does not require texture (nor is texture specified) but does require quality workmanship. Level 5 finish is SMOOTH. In DFW market, this level of finishing is often performed by painters and often sub-contractors try to substitute or provide a lower level of finish. This must be carefully watched in mockup review and C/A to ensure the specified finish level is actually provided, particularly in highly visible / public locations.

3. Level 5: All joints and interior angles shall have tape embedded in joint compound and three separate coats of joint compound applied over all joints, angles, fastener heads, and accessories. A thin skim coat of joint compound, or a material manufactured especially for this purpose, shall be applied to the entire surface. The surface shall be smooth and free of tool marks and ridges. Finished work free of noticeable defects which include joint ridging, staved joints, board edges damaged or out of place, joint blisters, nail pops, pinholes in joint treatment or any other noticeable defects. Finished work true to line, perfectly smooth and ready for painting or wall covering.
4. Prepared surfaces shall be coated with a primer/sealer prior to the application of finish paint. Refer to specification Division 9 Section for painting.
    a. Application: For use where gloss semi-gloss, enamel, eggshell, or non-textured flat paints are specified or where severe lighting conditions occur. Generally in all areas except where noted otherwise.

3.06 FIELD QUALITY CONTROL

A. Above-Ceiling Observation: Before Contractor installs gypsum board ceilings, Architect will conduct an above-ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
    1. Notify Architect seven days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation.
    2. Before notifying Architect, complete the following in areas to receive gypsum board ceilings:
        a. Installation of 80 percent of lighting fixtures, powered for operation.
        b. Installation, insulation, and leak and pressure testing of water piping systems.
        c. Installation of air-duct systems.
        d. Installation of air devices.
        e. Installation of mechanical system control-air tubing.
        f. Installation of ceiling support framing.

3.07 PATCHING AND REPAIR

A. Contractor shall repair and patch around penetrations in existing walls where new piping, ductwork, conduit, cables, etc. are required.

B. Remove and replace gypsum board panels that become wet, moisture damaged, or exhibit evidence of mold.

3.08 CLEANING

A. Contractor shall completely clean all areas affected by this work and shall leave no excess or scrap materials or bedding compound on the job site.

END OF SECTION 09 21 00

SECTION 09 25 23 - LIME BASED PLASTERING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Interior decorative polished lime based plaster finish system for installation over new gypsum board partitions.

B. Related Sections:
   1. Division 09 Section - Gypsum Board Assemblies: Preparation and use of abuse resistant substrate.

1.03 REFERENCES

A. ASTM D 1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes; 1998.

B. ASTM D 2486 - Standard Test Method for Scrub Resistance of Wall Paints; 1996.

C. ASTM D 3363 - Standard Test Method for Film Hardness by Pencil Test; 1992a.

D. ASTM E 84 - Standard Test method for Surface Burning Characteristics of Building Materials; 1999.

1.04 SYSTEM PERFORMANCE REQUIREMENTS

A. Polished plaster system shall be tested by a qualified independent testing agency for the following properties according to the following test methods:
   1. Pencil Hardness: Minimum of 5H+ when tested in accordance with ASTM D3363.
   2. Scrub Resistance: Minimum 10,000 cycles using 10 grams of scrubbing medium and 5 grams of water applied by brush.
   3. Chemical Exposure: Passes ASTM D 1308.

1.05 SUBMITTALS

A. Product Data: Provide manufacturer's technical data on products specified, including installation instructions.

B. Samples: Submit samples, 12 x 12 inches in size, illustrating finish color and texture.

C. Qualification Data: Certificate issued by distributor indicating that installer has attended training class and is authorized to install specified product.

D. Warranty: Sample copy of manufacturer's warranty stating obligations, remedies, limitations, and exclusions of warranty.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of this Section with a minimum of one year documented experience. Include list of at least three completed projects of similar scope with project names and addresses and names and addresses of architects and owners.

B. Single Source Responsibility: Provide only proprietary, factory-formulated materials as produced for applications indicated. Substitutes within the system are not permitted.

C. Fire-Test-Response Characteristics: Provide finished system with the following surface-burning characteristics as determined per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
   1. Flame Spread: 10 or less.
   2. Smoke Contribution: 10 or less.

1.07 MOCK-UP

A. Prior to installing polished plaster, construct mock-up of finished surface, 100 sq. ft. minimum, illustrating surface finish and color.

B. Locate where directed by Architect.

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

1.08 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the construction site in their original packaging with manufacturer's labels identifying manufacturer and product; color designation; lot number; and date of manufacture.

B. Inspect materials upon delivery and immediately report to Architect damaged or defective materials.

C. Store materials in a well ventilated area with minimum ambient temperature of 45º F (7º C). Prevent deterioration due to moisture, temperature changes, contamination, or other causes.

1.09 PROJECT CONDITIONS

A. Environmental Requirements: Do not apply polished plaster when substrate or ambient air temperatures is under 45º F (7º C) or over 95º F (35ºC).

B. Maintain these conditions 24 hours before, during and after installation of polished plaster.

1.10 WARRANTY

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

B. Provide manufacturer's standard written warranty.
   1. Period of Warranty: 10 years.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis of design Manufacturer: Armourcoat Surface Finishes, Inc., 4330 Production Court, Las Vegas, NV 89115. Tel: (702) 644-0601. Fax: (702) 644-0554. Web: www.armourcoat.com. Installer Contact: Southwest Progressive, Jim Reed at (972) 424 8280.

B. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include the following:
   1. Mediterranean Colors, LLC; eco stucco Interior System
   2. TexSton Industries, Inc.
   3. Triarch Fine Architectural Finishes

2.02 PRODUCTS

A. Products: Basis of design: Armourcoat Polished Plaster, Armourcoat Ltd.

B. Design: Two single-color finishes shown on architectural drawings and as approved on shop drawings.

C. Finish: Travertine.

D. Color: Two custom colors as selected by Architect.

2.03 MATERIALS

A. Polished Plaster System: Provide manufacturer's complete system of proprietary materials specifically formulated for compatibility with one another and which may include primer, keycoat, resin, finish coat, and wax polish as required for designs, finishes, and colors specified.

B. Water: Clean, fresh, potable and free of mineral or organic matter which can affect plaster.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify the suitability of existing conditions before starting work. Do not begin Work of this Section until unsatisfactory conditions have been corrected.

B. Acceptable Substrate Tolerances: Verify that substrates are true and level. Substrates shall be constructed to the following tolerances:
   1. ± 0.05 inches in 2 feet and ± 0.15 inches in 6 feet.
   2. Abuse resistant gypsum board: Minimum Level 4 finish.

3.02 PREPARATION

A. Comply with manufacturer's written instructions for substrate preparation.

B. Remove hardware, electrical switch and outlet plates, lighting fixtures and other items already in place that are not to receive plaster finish.
   1. After completion of work, reinstall items using workers skilled in the trades involved.

C. Protect adjacent surfaces and items that are not to receive plaster finish, but which cannot be removed, from finish work. Use masking materials that will not damage protected items and surfaces.

D. Clean substrates of substances that could impair bond including mold, mildew, oil, grease, salts, contamination and dirt using methods recommended by manufacturer.

E. Prepare all materials in accordance with manufacturer's recommendations.

3.03 INSTALLATION

A. Comply with manufacturer's written instructions for substrate preparation.

B. Remove hardware, electrical switch and outlet plates, lighting fixtures and other items already in place that are not to receive plaster finish.
   1. After completion of work, reinstall items using workers skilled in the trades involved.

C. Protect adjacent surfaces and items that are not to receive plaster finish, but which cannot be removed, from finish work. Use masking materials that will not damage protected items and surfaces.

D. Clean substrates of substances that could impair bond including mold, mildew, oil, grease, salts, contamination and dirt using methods recommended by manufacturer.

E. Substrate: For gypsum board substrates, apply coats of joint compound over joints and fasteners to achieve a minimum of a Level 4 finish. Use ready-mixed or job-mixed, drying-type, all-purpose or topping compound, or proprietary product specifically formulated for joint coating. Touch up and sand as needed to produce a surface free of visual defects, tool marks, or ridges, and conforming to a smooth flat surface. Only apply Polished Plaster to Regular Gypsum Board that is fire resistant and complies with ASTM C 1396. Do not use moisture resistant Gypsum Boards.

F. Prepare all materials in accordance with manufacturer’s recommendations.

G. Prime Coat: Where recommended by manufacturer, apply prime coat. Allow to dry.

H. Keycoat: Mix and apply Keycoat in accordance with manufacturer’s instructions. Allow to dry.

I. Finish: Apply finish coats as recommended by manufacturer to achieve desired results. Number of coats and total dry mil thickness shall be as recommended by manufacturer for specified system. Allow to dry.

J. Wax: Apply wax to obtain sheen in accordance with manufacturer’s instructions using type of wax recommended by manufacturer for particular finish.

K. Provide finish free of unsightly variations in texture and other defects.

3.04 CLEANING AND PROTECTION

A. Remove temporary coverings used to protect adjacent surfaces and reinstall hardware, plates, lighting fixtures and other items previously removed.

B. Clean and repair adjacent surfaces and items soiled or damaged during Work of this Section.

C. Maintain and protect completed polished plaster surfaces until time of acceptance at Substantial Completion.

END OF SECTION 09 25 23

SECTION 09 54 26 - LINEAR WOOD CEILINGS

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. Concealed suspension system for Wood Ceiling Panels.
   2. Trim and accessories.

B. Related Sections include the following:
   1. Division 09 Section: “Acoustical Insulation.”, for acceptable types of batt insulation.
   2. Divisions 21-23 Sections for “Mechanical” for work to be coordinated with wood ceiling.
   3. Divisions 26-28 Sections for “Electrical” and light fixture coordination.

1.03 QUALITY ASSURANCE

A. ASTM A 641: Standard Specification for Zinc Coated (Galvanized) Carbon Steel Wire; 1992.

B. ASTM C 423: Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 1990.

C. ASTMC C 635: Standard Specifications for Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.

D. ASTM C 636: Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels; 1992.

E. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials; 1991.

F. AWI (QSI): Architectural Woodwork Quality Standards Illustrated; 2003.

G. CISCA: Ceiling Systems Handbook.

H. Manufacturer Qualifications: Manufacturers other than those listed in Paragraph 2.1 are required to submit for approval prior to bidding per Section One.

I. Installer Qualifications: Engage an experienced Installer, approved by wood ceiling manufacturer, who has completed panel ceilings similar in species, design, and extent to that indicated for this Project and with a record of successful in-service performance.

J. Inspection: All work must pass inspection and approval of architect, as well as the local codes and regulations or authorities having jurisdiction.

K. Single-Source Responsibility for Wood Ceiling and Wall System: Obtain each type of Linear Wood Ceiling Panels from a single fabricator, with in-house Shop Drawing capabilities, in-house assembly and finishing capabilities, and with resources to provide products of consistent quality in appearance and physical properties without delaying the project.

L. Pre-Installation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings." Coordinate all interface with wood ceilings by other trades.

1.04 SUBMITTALS

A. Product Data: Manufacturer's product specifications and installation instructions for each material required, and for each suspension system, including certified laboratory test reports and other data as required to show compliance with these specifications.

B. Samples: For verification of each type of exposed finish required, prepared on samples of size indicated below. Where finishes involve normal color and texture variations, include sample sets showing the range of variations expected. 12” x 18” sample of each panel type, pattern, and color.

C. Shop Drawings: Provide Shop Drawings / Coordination Drawings for all ceilings, which should include RCP and product details. Coordinate Linear Wood ceiling and wall panel layout and installation of wood wall panels and suspension system components with other construction elements that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system components, partition assemblies and all perimeter conditions. Show size and location of all lift-out access panels required in wood ceiling.

1.05 PROJECT CONDITIONS

A. Space Enclosure and Environmental Limitations: Do not install wood panel ceilings and wood wall panels until spaces are enclosed and weatherproof, wet-work in spaces is completed and dry, work above ceilings is complete, and ambient temperature and humidity conditions are being maintained at the levels indicated for Project when occupied for its intended use.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Delivery & Unloading: Coordinate crate sizes, weights, unloading options, and delivery schedule with manufacturer prior to fabrication. Deliver wood panels and suspension system components to Project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other mistreatment.

B. Climatization: Before installing wood panels, permit them to reach room temperature and a stabilized moisture content (at least 72 hours) per AWI standards.

C. Handling: Handle Linear Wood Ceiling Panels carefully to avoid chipping edges or damaging units in any way.

D. Protection: Follow good safety and industrial hygiene practices during handling and installing of all products and systems, with personnel to take necessary precautions and wear appropriate protective equipment as needed. Read related literature for important information on products before installation.

1.07 WARRANTIES

A. Provide owner with a (1) year warranty for material and workmanship on all installed products. Manufacturers: All materials, wood ceiling and grid, shall be warranted for (1) one year for material and workmanship. Installer: All work shall be warranted for (1) year from final acceptance of completed work.

PART 2 - PRODUCTS

2.01 WOOD CEILING WITH SUSPENSION SYSTEM

A. General: Provide veneer wood ceiling system from one of the following manufacturers, or equal:
   1. Rulon Company (www.rulonco.com)
   2. 9wood, Inc. (Bruce Michelich, Architectural Materials, Phone (972) 377-8777, www.9wood.com)
   3. Architectectural Components Group, Inc. (agciwood.com)

2.02 WOOD CEILING PANELS

A. Basis of Design: Rulon International, St. Augustine, FL 32092 • (800) 227-8566

B. WD-1 Grille: Rulon Panel Grille – PG 4-12-60, solid maple, with continuous black scrim attached above, stained color to match architect's sample.

2.03 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal T-Grid Suspension System: Provide standard interior Metal Heavy Duty 15/16" suspension T-Grid system using Main Runners, Cross-tees, Wall Angle or Shadow Moldings of types, structural classifications, and black finishes indicated and that comply with applicable ASTM C 635 requirements. Comply with all applicable codes and ordinances.

B. Attachment Devices: Size for 3 times the design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

C. Backer clips as required for removeable sections for access above ceiling. Fabricate lift-out sections so that lines between adjacent panels are straight and aligned, with minimal width joints.

D. Wire, Braces, Ties, Hanger Rods, Flat Hangers and Angle Hangers: Provide wires, rods and hangers that comply with applicable ASTM specifications.

E. Acoustical insulation: Install with 2" thick acoustical mineral fiber batt installed continuously above ceiling panels. Acoustical batts made with binder containing no added urea formaldehyde. Spray paint underside of insulation flat black prior to installation.

PART 3 - EXECUTION

3.01 COORDINATION

A. Carefully coordinate light fixtures, sprinkler heads, and other Mechanical, Plumbing, and Electrical items installed in wood ceilings, prior to ordering material. Inform Architect of any apparent conflicts. Generally, locate vacancy sensors, wireless internet access, fire alarm devices, and other similar items on walls or on gypsum furr-downs at perimeter of the ceiling wherever possible, instead of installed within the area of the wood ceiling.

B. Coordinate sprinkler heads installed in wood panel ceilings to be flat black in color and to be installed to project as little distance as allowed by authorities having jurisdiction below the plane of the ceiling.

3.02 INSTALLATION

A. Ceiling grids and wood panels completely installed in all areas indicated. Ceiling plenum shall be completely enclosed from adjoining conditioned space by structure, partitions, and/or acoustical panels.

B. Suspension systems installed by direct suspension from structural systems in accordance with manufacturer's specification. Hanger wire shall support no greater than 16 square feet. Install additional hangars at ends of each suspension member, at each end of light fixtures, and 6 inches from vertical surfaces. Do not splay wires more than 5 inches in a 4 foot drop. Bottom of surfaces shall be flush and level. Miter corners where wall moldings intersect.

C. Installation of Metal T-Bar Grid: Install, align, brace, tie-off, mount, handle interferences, and space suspension T-Grid in accordance with suspension manufacturer's instructions and in compliance with all local codes and regulations.

D. Installation of Rulon Wood Systems: Install wood and wall ceiling panels in accordance with manufacturer's installation instructions and in compliance with all local codes and regulations. Install with undamaged edges and fitted accurately to suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit, as required. Panels to be installed in flat plane with no visibal sag, warp or rotation between panels.
   1. Provide lift-out access panel sections of ceilings where indicated in Drawings and where required to access equipment above for maintenance or by building code. Size openings for passage (approximately 24" to 30" square) unless larger size is required for servicing equipment above ceiling. Make access panels as inconspicuous as possible in the completed work.

E. Install acoustical batts above metal panels. Spray paint black prior to installation so that color of batts is not visible when looking up between wood slats and through the black scrim fabric.

F. The plumbing and heating contractors shall not utilize hangars or framing of suspension system. The electrical contractor may utilize suspension system for lay-in fixture installation but shall furnish two supplementary hangars per fixture for maintaining maximum load deflection. Electrical contractor shall not utilize tile as sole support for any ceiling-mounted electrical device. All ceiling-mounted electrical devices shall be supported with brackets attached to tees.

G. Ceilings laid out as shown on the drawings, however, if not specifically shown, ceilings laid out from center of room in both directions so that cut wood panels are equal at all edges. Place materials to have full bearing on suspension members.

H. General Contractor shall coordinate location of item requiring access to minimize number of access panels, by code. Consult Architect on exact location of access panels.

I. Architect reserves the right to reject panels with uneven or jagged edges. Edges of black reveal scrim shall be cut straight at perimeter edges in line with wood slats. No Hanging, frayed, or visibly damaged fabric will be accepted.

3.03 CLEANING

A. General: Clean exposed wood surfaces of Rulon Wood Ceiling and Wall Panels. Comply with manufacturer's instructions for cleaning and touchup of minor finish damage. Remove and replace wood ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

3.04 INSPECTION

A. Following installation, soiled or discolored units cleaned to match adjacent perfect material. Any broken or damaged material which cannot be corrected by cleaning, removed and replaced with perfect material.

END OF SECTION 09 54 26

SECTION 09 66 23 - RESINOUS MATRIX TERRAZZO 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. Section Includes:
   1. Thin-set, epoxy-resin terrazzo flooring.
   2. Precast epoxy-resin terrazzo cove base.
   3. Precast epoxy-resin terrazzo stair units.
   4. Precast epoxy-resin terrazzo custom bench.

B. Related Requirements:
   1. Division 05 Section "Metal Fabrications" for miscellaneous steel to support bench.
   2. Division 05 Section "Metal Stairs".
   3. Division 07 Section "Joint Sealants" for sealants installed with terrazzo.
   4. Division 09 Section "Gypsum Board Assemblies" for framing to support bench.

1.03 DEFINITIONS

A. Aggregate: Marble chips or other types of aggregate.

1.04 ACTION SUBMITTALS

A. Product Data: Manufacturer's printed installation and product data for each type of product.

B. Shop Drawings: Include terrazzo installation requirements. Include plans, elevations, sections, component details, and attachments to other work. Show layout of the following:
   1. Divider strips.
   2. Control-joint strips.
   3. Accessory strips.
   4. Abrasive strips.
   5. Stair treads, risers, and landings.
   6. Precast terrazzo jointing and edge configurations.
   7. Terrazzo patterns.

C. Samples: For each exposed product and for each color and texture specified, 6 inches in size.

D. Samples for Initial Selection: NTMA color plates showing the full range of colors and patterns available for each terrazzo type.

E. Samples for Verification: For each type, material, color, and pattern of terrazzo and accessory required showing the full range of color, texture, and pattern variations expected. Label each terrazzo sample to identify manufacturer's matrix color and aggregate types, sizes, and proportions. Prepare Samples of same thickness and from same material to be used for the Work, in size indicated below:
   1. Terrazzo: Two (2) minimum 6-inch square Samples showing colors and finish.
   2. Precast Terrazzo: Two (2) 6-inch square Samples showing colors and finish.
   3. Accessories: Two (2) 6-inch long Samples of each exposed strip item required.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Material Certificates: For each type of terrazzo material or product, from manufacturer. Manufacturer's certification that materials installed meets specification requirements.

C. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements. Provide a letter certifying that the installer is a member of the NTMA.

D. Provide manufacturer's maintenance recommendations for inclusion in Operations and Maintenance Manual.

1.06 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Engage an installer who is certified in writing by terrazzo manufacturer as qualified to install manufacturer's products.
   2. Actively engaged in the installation of specified materials for a minimum of the past five (5) years.
   3. A contractor member of NTMA or certified to perform all work in accordance with NTMA standards.

B. Source Limitations: Obtain primary terrazzo materials from single source from single manufacturer. Provide secondary materials including patching and fill material, joint sealant, and repair materials of type and from source recommended by manufacturer of primary materials.

C. Source Limitations for Aggregates: Obtain each color, grade, type, and variety of granular materials from single source with resources to provide materials of consistent quality in appearance and physical properties.

D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Build mockups for terrazzo including accessories.
      a. Size: Minimum 100 sq. ft. of typical poured-in-place flooring and base condition for each color and pattern in locations directed by Architect.
      b. Include base first three stair treads.
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in supplier's original wrappings and containers, labeled with source's or manufacturer's name, material or product brand name, and lot number if any.

B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.08 FIELD CONDITIONS

A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting terrazzo installation.

B. Field Measurements: Verify actual dimensions of construction contiguous with precast terrazzo by field measurements before fabrication.

C. Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during terrazzo installation.

D. Close spaces to traffic during terrazzo application and for not less than 24 hours after application unless manufacturer recommends a longer period.

E. Control and collect water and dust produced by grinding operations. Protect adjacent construction from detrimental effects of grinding operations.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. NTMA Standards: Comply with NTMA's "Terrazzo Specifications and Design Guide" and with written recommendations for terrazzo type indicated unless more stringent requirements are specified.

2.02 EPOXY-RESIN TERRAZZO

A. Epoxy-Resin Terrazzo: Comply with NTMA's "Terrazzo Specifications and Design Guide" and manufacturer's written instructions for matrix and aggregate proportions and mixing.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Master Terrazzo Technologies.
      b. General Polymers (a subsidiary of Sherwin Williams).
   2. Thickness: 1/4 inch.
   3. Formulated Mix Color and Pattern: Custom color to match Architects' sample.

B. Materials:
   1. Primer: Type recommended and produced by manufacturer of epoxy resin composition for type of service and floor condition indicated.
      a. Basis of Design: Subject to compliance with requirements, provide the following products, or approved comparable products by another manufacturer: Morricite Primer.
   2. Flexible Reinforcing Membrane: Type recommended and produced by manufacturer of epoxy resin composition for type of service and floor condition indicated.
      a. Basis of Design: Subject to compliance with requirements, provide the following products, or approved comparable products by another manufacturer: MasterFlex Flexible Epoxy Membrane with 100 percent solids with the following properties:
         1) Tensile Strength: ASTM D2370 at 68° F, 1,500 psi.
         2) Elongation: ASTM D2370 at 68° F 130 percent.
         3) Adhesion: ASTM D4541, 250 psi.
   3. Epoxy-Resin Matrix: Manufacturer's standard recommended for use indicated.
      a. Physical Properties without Aggregates:

         Provide flooring system that meets or exceeds the listed minimum physical property requirements using specified epoxy matrix incorporating marble aggregate as per manufacturer’s mix recommendations when tested according to the referenced standard test method in parentheses.

         1) Hardness (ASTM D2240): 70-85 Shore D
         2) Compressive Strength (ASTM D695): 12,000 psi
         3) Impact Resistance (MIL-PRF-3134 Para 4.7.3): 0.005" indentation, no loosening or cracking
         4) Indentation Resistance (MIL-PRF-3134, Para. 4.7.4.2.1): No Indentation
         5) Adhesion (A.C.I. Committee 503.1): >525 psi.
            a) 100% failure in concrete
         6) Resistance to Elevated Temperatures (MIL-PRF-3134 Para. 4.7.5.1): No slip, flow or softening.
         7) Co-efficient of Linear Expansion (ASTM D696): 14 x 10^6 (max.) per degree F/12^0
            a) F to 140^0 F
         8) Tensile Strength (ASTM C638): 4,800 psi.

9) Flammability (FTMS 372/NFPA 253/ ASTM E648): Greater than 1.07 watts/cm.
10) Chemical Resistance: No deleterious effects by contaminants listed below after 7-day immersion at room temperature per ASTM D1308.
a) Distilled Water
b) Mineral Water
c) Isopropanol
d) Ethanol
e) 0.025 percent detergent solution
f) 1 percent soap solution
g) 10 percent sodium hydroxide
h) 10 percent hydrochloric acid
i) 5 percent acetic acid

b. Physical Properties with Aggregates: For resin blended with Georgia white marble, ground, grouted, and cured per requirements in NTMA's "Terrazzo Specifications and Design Guide"; comply with the following:
1) Flammability: Self-extinguishing, maximum extent of burning 1/4 inch per ASTM D 635.
2) Thermal Coefficient of Linear Expansion: 0.0025 inch/inch per deg F for temperature range of minus 12 to plus 140 deg F per ASTM D 696.
3) Bond Strength: When tested in accordance with Field Test Method for surface soundness and adhesion as described in ACI Committee No. 403 Bulletin Tile No. 59-43 the Epoxy terrazzo shall comply with the following value: 100 percent concrete failure minimum, with 300 psi minimum tensile strength.

4. Aggregates: Granite. Comply with NTMA gradation standards for mix indicated and contain no deleterious or foreign matter.
a. Sizes: #2's, #1's and "0's conforming to NTMA gradation standards.
b. Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C 131.
c. 24-Hour Absorption Rate: Less than 0.75 percent.
d. Dust Content: Less than 1.0 percent by weight.
e. Chips shall contain no deleterious or foreign matter.
5. Finishing Grout: Resin based.

2.03 PRECAST EPOXY-RESIN TERRAZZO

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Master Terrazzo Technologies.
2. General Polymers (a subsidiary of Sherwin Williams).

B. Precast Terrazzo Units: Comply with NTMA's written recommendations for fabricating precast terrazzo units in sizes and profiles indicated. Reinforce units as required by unit sizes, profiles, and thicknesses and as recommended by manufacturer. Finish exposed-to-view edges and reveals to match face finish. Ease exposed edges to 1/8-inch radius.
1. Integral stair treads and risers.
2. 4" high cove base.
3. Color, Pattern, and Finish: As selected by Architect from full range of industry colors. Match adjacent poured-in-place terrazzo flooring.

2.04 STRIP MATERIALS

A. Heavy-Top Divider Strips: L-type angle in depth required for topping thickness indicated.
1. Bottom-Section Material: Matching top-section material.
2. Top-Section Material: White-zinc alloy

3. Top-Section Width: 1/8 inch

B. Control-Joint Strips: Separate, double L-type angles, positioned back to back, that match material and color of divider strips and in depth required for topping thickness indicated.

C. Accessory Strips: Match divider-strip width, material, and color unless otherwise indicated. Use the following types of accessory strips as required to provide a complete installation:
   1. Base-bead strips for exposed top edge of terrazzo base. 18 B and S gauge white-zinc alloy.
   2. Edge-bead strips for exposed edges of terrazzo.

D. Transition Strips
   1. Type: Anodized aluminum metal transitions
   2. Acceptable Manufacturer: Ceramic Tool Company or approved equal
   3. Color: Medium Bronze
   4. Location: Terrazzo / Concrete: CTC Tranz

E. Abrasive Strips: Two-line abrasive inserts at nosings. Silicon carbide or aluminum oxide, or combination of both, in epoxy-resin binder and set in channel.
   1. Width: 1/2 inch
   2. Depth: As required by terrazzo thickness.
   3. Length: 4 inches less than stair width
   4. Color: As selected by Architect from full range of industry colors

2.05 MISCELLANEOUS ACCESSORIES

A. Strip Adhesive: Epoxy-resin adhesive recommended by adhesive manufacturer for this use.
   1. Adhesives shall have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Anchoring Devices:
   1. Strips: Provide mechanical anchoring devices or adhesives for strip materials as recommended by manufacturer and required for secure attachment to substrate.
   2. Precast Terrazzo: Provide mechanical anchoring devices as recommended by fabricator for proper anchorage and support of units for conditions of installation and support.

C. Patching and Fill Material: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.

D. Joint Compound: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.

E. Resinous Matrix Terrazzo Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by sealer manufacturer for use on terrazzo type indicated.

F. Sealer: Slip- and stain-resistant, penetrating-type sealer that is chemically neutral; does not affect terrazzo color or physical properties; is recommended by sealer manufacturer; and complies with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo type indicated.
   1. Surface Friction: Not less than 0.6 according to ASTM D 2047.
   2. Acid-Base Properties: With pH factor between 7 and 10.
   3. Sealers shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

4. Water Based Sealer: Provide a medium gloss water based sealer and finish system MTT SealOn Waterborne Sealer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions, including levelness tolerances, have been corrected.

3.02 PREPARATION

A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.

B. Concrete Slabs:
   1. Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with terrazzo.
      a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and re-circulates the shot by vacuum pickup.
      b. Repair damaged and deteriorated concrete according to terrazzo manufacturer's written recommendations.
      c. Use patching and fill material to fill holes and depressions in substrates according to terrazzo manufacturer's written instructions.

C. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
   1. Moisture Testing: Perform tests indicated below.
      a. Calcium Chloride Test: Perform anhydrous calcium chloride test per ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
         1) Perform tests so that each test area does not exceed 200 sq. ft., and perform not less than two tests in each installation area and with test areas evenly spaced in installation areas.
      b. In-Situ Probe Test: Perform relative-humidity test using in-situ probes per ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative-humidity-level measurement.
      c. Test Method: Test for moisture content by method recommended in writing by terrazzo manufacturer. Proceed with installation only after substrates pass testing.

D. Protect other work from water and dust generated by grinding operations. Control water and dust to comply with environmental protection regulations.

3.03 EPOXY-RESIN TERRAZZO INSTALLATION

A. General: Apply each component of epoxy matrix terrazzo flooring system according to manufacturer's directions to produce a uniform monolithic flooring surface of thickness indicated.

B. Flexible Reinforcing Membrane: Membrane application for crack prevention. Route out all cracks and fill with semi-flexible joint filler. Apply membrane (spread at 40 mils thickness) over prepared substrate to produce full substrate coverage in areas to receive terrazzo.

C. Primer / Bond Coat: Apply epoxy bond coat over prepared substrate at manufacturer's recommended spreading rate.

D. Divider Strips: Set divider strips as indicated on plans. Strips shall be set in a full bed of epoxy adhesive and allowed to cure before proceeding with the work.

E. Body Coat: Over bond coat surface trowel apply epoxy matrix terrazzo to thickness of 3/8. Seed the surface with additional aggregate of the same blend as the trowel applied mortar. Work the aggregate into the surface to an even aggregate chip dispersion. Compact the matrix into a tight even compound.

F. Grinding: Grind floor using terrazzo grinding machines, mounting progressively finer grit stones to achieve flat surface with uniform exposure of marble chips.

G. Grouting and Finish Grind: Grout floor with epoxy resin and finish grind to remove grout.

H. Sealing Coats: Apply sealing coats of type recommended by manufacturer to produce finish matching approved samples. Finished floor shall be 3/8" thick.

I. Comply with NTMA's written recommendations for terrazzo and accessory installation.

J. Place, rough grind, grout, cure grout, fine grind, and finish terrazzo according to manufacturer's written instructions and NTMA's "Terrazzo Specifications and Design Guide."

K. Installation Tolerance: Limit variation in terrazzo surface from level to 1/4 inch in 10 feet; noncumulative.

L. Ensure that matrix components and fluids from grinding operations do not stain terrazzo by reacting with divider and control-joint strips.

M. Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted.

N. Water Proofing Membrane:
   1. Prepare and prefill substrate cracks with membrane material.
   2. Install membrane to produce full substrate coverage at suspended slabs in areas to receive terrazzo.
   3. Prepare membrane according to manufacturer's written instructions before applying substrate primer.

O. Primer: Apply to terrazzo substrates according to manufacturer's written instructions.

P. Strip Materials:
   1. Divider and Control-Joint Strips:
      a. Locate divider strips in locations indicated and as recommended by manufacturer.
      b. Install control-joint strips back to back directly above concrete-slab control joints.
      c. Install control-joint strips with 1/4-inch gap between strips, and install sealant in gap.
      d. Install strips in adhesive setting bed without voids below strips, or mechanically anchor strips as required to attach strips to substrate, as recommended by strip manufacturer.
   2. Accessory Strips: Install as required to provide a complete installation
   3. Abrasive Strips: Install with surface of abrasive strip positioned 1/16 inch higher than terrazzo surface.

3.04 PRECAST TERRAZZO INSTALLATION

A. Install precast terrazzo units using method recommended by NTMA and manufacturer unless otherwise indicated.

B. Do not install units that are chipped, cracked, discolored, or not properly finished.

C. Seal joints between units with joint compound matching precast terrazzo matrix.

D. Setting:
   1. Set accurately as shown on approved shop drawings. Setting methods are:

a. Thin Set
b. Epoxy
c. Bolt

2. Alignment of precast should be straight and true to all dimensions. It may not vary more than 1/8" in length, height or width.
3. Install anchors as shown on details.
4. Fill joints between with manufacturer approved caulk.

3.05 REPAIR

A. Cut out and replace terrazzo areas that evidence lack of bond with substrate. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by Architect.

3.06 CLEANING AND PROTECTION

A. Cleaning:
   1. Remove grinding dust from installation and adjacent areas.
   2. Wash surfaces with cleaner according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow them to dry thoroughly.

B. Sealing:
   1. Seal surfaces according to NTMA's written recommendations.
   2. Apply sealer according to sealer manufacturer's written instructions.

C. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure that terrazzo is without damage or deterioration at time of Substantial Completion.

END OF SECTION 09 66 23

SECTION 09 68 00 - CARPETING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Perform all work required to complete the Carpeting indicated by the Contract Documents and all work that can be reasonably inferred to be included. Furnish all supplementary items necessary for its proper installation.

B. Related Documents: The Contract Documents, as defined in Division 01 Section - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other Documents.

C. Related Sections include the following:
   1. Division 9 Section “Resilient Flooring.”
   2. Division 9 Section “Rubber Base.”

1.03 SUBMITTALS

A. Product Data:
   1. Submit manufacturer's complete technical product data for each type of carpet, cushion and accessory item required, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation

B. Shop Drawings:
   1. Furnish plan for each area to receive carpet, showing locations of all seams.

C. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.
   1. 18" x 18" sample of each type carpet specified and full color range available.
   2. 6" long sample of each type exposed edge.
   3. 6" square samples of separate cushions.
   4. 18" long sample of each accessory item.

D. Manufacturer's Installation Instructions: Indicate special procedures.

E. Maintenance Instructions:
   1. Carpet manufacturer shall give a written maintenance outline to the Owner for proper care of the installed material. This shall include type of cleaning apparatus to use, type of cleaning agent required and material suppliers address.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver all materials to the project properly protected taking care not to damage any materials.

1.05 JOB CONDITIONS

A. Environmental Requirements: Temperature of rooms in which carpeting is to be installed shall be properly maintained at adhesive manufacturer's recommended levels.

B. Field Measurements: Written dimensions shall take precedence over scaled plan sizes. All dimensions are approximate and the Contractor shall be responsible for verifying all dimensions and conditions in the field prior to installation.

1.06 CONTRACTOR QUALIFICATIONS

A. The Contractor shall be experienced in the supervision of carpet installation, with at least five (5) years experience in this type of work. The actual work shall be done by qualified and experienced mechanics working under his supervision or under the supervision of an experienced workroom supervisor who has also been doing this type of work for five years.

1.07 ACCEPTABLE MANUFACTURERS

A. The following products/manufacturers are acceptable:

Mohawk Group

PART 2 - PRODUCTS

2.01 MATERIAL

A. Carpet: Woven construction of Antron fiber, 4 ply yarn, 7 rows per inch minimum, with a combination of rows and pitch to achieve 1320 loops per square inch minimum, minimum face weight of 24 oz. per square yard, minimum total weight of 56 oz. per square yard, yarn dyed, with static control below 3.5 K.V., Class I, flammability meeting NFPA-253 and ASTM-E648 (.45 watts/cm2), smoke density meeting NFPA-258 - 450 or less, 12' wide rolls. Allow for two colors of carpeting from manufacturer's standard range to be selected by Architect.

B. Carpet Tile: Fusion bonded, manufactured in one color dye lot:
   1. Basis of Design: Subject to compliance with requirements, provide the following products, or approved comparable products by another manufacturer:
      a. Mohawk Group, Caliber BT282, 24”x24”, color: 7568 “Marble”

C. Pad: "Tred-Mor" #1562-2 Sponge rubber commercial carpet cushion as manufactured by Sponge Cushion, Inc.

D. Adhesive: Waterproof type recommended in writing by carpet manufacturer to suit this application and expected service.

E. Edge Strips: Rubber butting gauge shall be Mercer's #EG-XX-B in color to match base, or approved equal.

F. Carpet Reducer: Rubber reducer #CRS-XX of height equal to carpeting, #CB-XX-C at VCT, and other accessories as made by Mercer, or approved equal. Colors as selected by the Architect from manufacturer's standards.

G. Carpet Tile Adapter: Rubber tile adapter equal to Mercer's #CTA-XX-A of color as selected by Architect from manufacturer's standards.

H. Attic Stock: Quantity equal to 1 percent of total installed of each color and pattern installed.

PART 3 - EXECUTION

3.01 WORKMANSHIP

A. The carpet manufacturer's recommended procedures for installation shall be closely followed. Particular attention is to be paid to recommendations for application of floor covering adhesive, seam cement and cross joining.

B. Carpet edgings shall be neatly trimmed for tight fit along walls, cut and fit evenly around all projections and into trim strips. Fit closely and evenly to, in and through doorways, terminating carpet under doors. Finished installation shall be smooth and free of ripples and puckers.

C. Carpet binder bar shall be supplied and installed as required at doorways and other openings adjoining hard surface materials. Secure with nails appropriate for substrate.

D. All carpet shall be laid in the same direction, unless specifically shown otherwise.

E. Lay carpet with absolute minimum number of seams. Do no use small carpet strips.

F. All cross joins necessary due to layout of areas shall be at the absolute minimum and shall be indicated on shop drawings.

G. Cross joins necessary due to length of rolls received shall be placed in the cutting to avoid occurrence at conspicuous locations, near doors or at pivot points, and must be approved prior to seaming.

H. Adhesive shall be applied to both edges of the carpet at a cross join. These edges shall be brought together to insure direct contact of the adjoining edges after application of the adhesive.

I. Spots and smears of floor covering adhesive and seam cement shall be removed immediately.

J. Perform initial vacuum cleaning of entire carpet installation areas and leave in perfect condition.

3.02 INSPECTION AND PREPARATION

A. Contractor shall inspect substrate before starting his work. Any objectionable conditions shall be brought to the attention of the Contractor. Any high ridges, excessive gaps or other items must be repaired prior to installation. Contractor is responsible to apply leveling material over uneven or rough surfaces.

B. Do not proceed with any work until such defects are entirely corrected. The Contractor shall carefully check all dimensions and other conditions in the facilities and shall be responsible for proper fitting of carpet in areas designated.

C. Before installation, remove all debris and job soiling with a vacuum cleaner and damp mop. Install tackless strip in accordance with manufacturer's directions.

D. The application or installation of carpet by the carpet contractor shall be an indication of his acceptance of the subfloor.

3.03 FLOOR INSTALLATION

A. Install carpet using direct glue method in accordance with carpet manufacturer's recommendations.

B. Carpet shall be installed with "Dubl-Stik" system as recommended by manufacturer.

C. Carpet shall be installed in the largest possible pieces. The use of small pieces and scraps will not be accepted.

D. Check carpet before beginning installations and ensure there is no visible variation between dye lots.

E. Cut and fit neatly around projections through floor and to walls or other vertical surface, leaving no gaps. Hardware items mounted to the substrate shall be removed and reinstalled following carpet installation.

F. Seams are to be kept to an absolute minimum. Seams shall receive a coating of edge sealer applied to base and side of pile yard, securing breadth and end to end. Seams installed so that they are practically invisible upon completion. Use adhesives applied in 6" bands at all cross (butt) seams and around perimeter of all areas. All woven selvages are to be trimmed to insure good side seams.

G. All edges shall be free from fraying. On all finished edges of carpet where it abuts an adjacent floor at the same or different level, finishing strips must be applied as specified. Finishing edges shall be mechanically fastened to substrate.

H. Metal edge mouldings shall be mitered at corners and mechanically fastened to substrate at 12" O.C. minimum. Do not fasten through carpet. Tap downs shall be installed without denting.

I. Entire carpet installation shall be unwrinkled, without twist, laid tight and flat to subfloor, well adhered, and present a uniform appearance. Ensure monolithic color, pattern and texture match within any one area.

J. Carpet step-off saddle and reducer strips shall be supplied and installed at doorways, where carpeting abuts dissimilar floor surfaces, and as required.

K. Do not place heavy objects such as furniture on carpeted surfaces for minimum of 24 hours or until adhesive has set.

L. Any carpet which wrinkles or loosens at seams within one year from date of installation shall be corrected at no cost to the Owner.

3.04 CLEAN-UP

A. After carpet installation is completed, remove all remnants, wrapping paper and debris. Neatly trim all sprouting tufts with sharp scissors. The Owner shall view all carpet scraps and retain any he chooses for future repairs before they are removed from the job site.

B. All carpeted areas shall be vacuumed thoroughly and left protected in a manner ready for occupancy.

END OF SECTION 09 68 00

SECTION 09 81 00 - ACOUSTICAL INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. General Coordination Procedures, (Reference Specification Section 01 31 00) General Contractor shall coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work that depend on each other for proper installation, connection, and operation.

1.02 SUMMARY

A. Section Includes:
   1. Provide sound insulation as shown on the drawings and as herein specified.

B. Related Sections include the following:
   1. Division 07 Section “Thermal Insulation.”
   2. Division 07 Section “Joint Sealants”, and Division 09 “Gypsum Board Assemblies”, for acoustical sealants and other acoustical components used in partition wall assemblies.

1.03 PERFORMANCE REQUIREMENTS

A. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

B. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency
   1. Batt Insulation: flame spread and smoke developed of 0. NFPA 101 Class A.
   2. Other insulation types: As indicated.

C. Low VOC: All batt insulation products shall be made with binder containing no added urea formaldehyde.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer's original packages, clearly marked with brand name, type and R-Value.

B. Store materials in area protected from weather, moisture and damage, remove any damaged materials from the site.

1.05 SUBMITTALS

A. Samples of materials and complete product and technical description submitted for approval to the Architect prior to ordering materials.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from slag wool, or rock wool. Unfaced batt insulation, 3-1/2" thick, with an R-Value of 15.
   1. STC-Rated Acoustical Assemblies: Comply with acoustical rating assembly requirements.
   2. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas receiving insulation work to insure work of preceding trades is completed. Check surfaces to see that they are uniform in place, free from mortar droppings, grease, oil or other debris which would affect proper insulation. Application constitutes acceptance of substrate conditions.

3.02 INSTALLATION

A. Insulation installed in accordance with current printed recommendations of insulation manufacturer.

B. Install sound batts tightly to studs and to all penetrations. Install tightly fitted and continuously behind and around conduit, boxes, pipe, and other obstructions. Install in full length pieces in each stud cavity to the extent possible to minimize the number of joints at cut ends. Fit cut ends pressed together to ensure a continuous acoustical barrier. Where the stud depth is greater than the nominal batt thickness, cut ends in mats shall be overlapped at least two inches.

END OF SECTION 09 81 00

SECTION 09 91 00 - PAINTING

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. Provide complete surface preparation, priming, field painting and sealing of exposed exterior and interior items and surfaces.
   1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
   2. Examine specifications for various other trades and their provisions regarding their painting. Surfaces that are left unfinished by other sections of specifications shall be painted or finished as a part of this section.

B. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
   1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.
   2. Painting includes all exterior galvanized or ferrous metal.

C. Do not paint prefinished items and finished metal surfaces except where otherwise noted in Drawings or specifications. Do not paint concealed surfaces, operating parts, and labels.
   1. Prefinished items include the following factory-finished components:
      a. Architectural woodwork.
      b. Elevator entrance doors and frames.
      c. Finished mechanical and electrical equipment.
      d. Light fixtures.
      e. Prefinished wall, roof & soffit panels
   2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
      a. Foundation spaces.
      b. Furred areas.
      c. Ceiling plenums.
      d. Pipe spaces.
      e. Duct shafts.
      f. Elevator shafts.
   3. Finished metal surfaces include the following:
      a. Anodized aluminum.
      b. Stainless steel.
      c. Chromium plate.
      d. Copper and copper alloys.
      e. Bronze and brass.
   4. Operating parts include moving parts of operating equipment and the following:
      a. Valve and damper operators.
      b. Linkages.

c. Sensing devices.
d. Motor and fan shafts.

5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

D. Related Sections include the following:
1. Division 5 Section "Structural Steel" for shop priming structural steel.
2. Division 5 Section "Metal Fabrications" for shop priming ferrous metal.
3. Division 6 Section "Architectural Woodwork" for shop priming interior architectural woodwork.
4. Division 7 Section "Joint Sealers ".
5. Division 8 Section "Wood Doors ".
6. Division 8 Section "Steel Doors and Frames" for factory priming steel doors and frames.
7. Division 8 Section "Wood Window & Door Restoration".
8. Division 9 Section "Plaster ".
9. Division 9 Section "Gypsum Board" for surface preparation of gypsum board.
10. Division 32 Section "Pavement Accessories" for traffic-marking paint.

1.03 DEFINITIONS

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.
1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
3. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

1.04 SUBMITTALS

A. Product Data: For each paint system indicated. Include block fillers and primers.
1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.

B. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.
1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.
3. Submit 3 samples on the following substrates for Architect's review of color and texture only:
a. Masonry: 6-by-10-inch samples of masonry, with mortar joint in the center, for each finish and color. (Field installation acceptable).
b. Painted Gypsum Board: 8-inch-square samples for each color and material on hardboard.
c. Stained or Natural Wood: 6-by-10-inch samples of natural- or stained-wood finish on representative Medium Red Oak surfaces.

d. Ferrous Metal: 4-inch- square samples of flat metal and 8-inch-long Samples of solid metal for each color and finish. (Field installation acceptable).
e. Plaster: 10-inch-square samples for each color. (Field installation acceptable).

C. Qualification Data: For Applicator.

D. The Contractor shall furnish the Owner with a booklet of actual samples of the colors used on the project at project completion.

1.05 QUALITY ASSURANCE

A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings 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.

B. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

C. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample for each type of coating and substrate required. Comply with procedures specified in PDCA P5. Duplicate finish of approved sample Submittals.
1. Architect and Owner will select one room or surface to represent surfaces and conditions for application of each type of coating and substrate.
a. Wall Surfaces: Provide samples on at least 100 sq. ft.
b. Small Areas and Items: Architect will designate items or areas required.
c. Portion of all wood to be finished or restored, including windows, doors, frames, rails, etc.
2. Apply benchmark samples, according to requirements for the completed Work, after permanent lighting and other environmental services have been activated. Provide required sheen, color, and texture on each surface.
a. After finishes are accepted, Architect will use the room or surface to evaluate coating systems of a similar nature.
3. Final approval of colors will be from benchmark samples.
4. Do not proceed with remaining work until the Architect and UTA Project Manager approves the mock-up.

D. Wood Sealer: Shall meet Fed. Spec. TT-W-572B for water repellence.

E. Materials shall be manufacturer's best grade of respective paint types.

F. Gloss levels for paints required are as per the National Paint and Coatings Association.

G. Prior to acid-etching of the concrete floor and application of the epoxy coating, an on-site conference of the applicator, contractor, Architect and manufacturer's representative shall review proper installation procedures.

H. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels unless indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.

7. Color name and number.
8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area at an ambient temperature between 45 and 95 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.
   1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

1.07 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F.

C. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F.

D. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
   1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

E. Provide adequate ventilation of spaces while applying primer and finish coats.

F. All application of coatings shall be done under adequate illumination.

1.08 EXTRA MATERIALS

A. Furnish extra paint materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.
   1. Quantity: Furnish Owner with an additional one percent, but not less than 1 gal. or 1 case, as appropriate, of each material and color applied.
   2. Indicate final color schedule used in Operation and Maintenance Manuals.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

C. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
   1. Benjamin Moore & Co. (Benjamin Moore).
   2. Kelly-Moore Paint Co. (Kelly-Moore).
   3. Sherwin-Williams Co. (Sherwin-Williams).
   4. Requests for substitutions will be considered in accordance with provisions of Section 01 31 00.

2.02 PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
   1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

C. Colors: Match Architect's samples.

D. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.03 CONCRETE UNIT MASONRY BLOCK FILLERS

A. Concrete Unit Masonry Block Filler: Factory-formulated high-performance latex block fillers.
   1. Benjamin Moore; Moorcraft Super Craft Latex Block Filler No. 285: Applied at a dry film thickness of not less than 8.1 mils.
   2. Benjamin Moore; Moore's IMC Latex Block Filler No. M88: Applied at a dry film thickness of not less than 8.1 mils.
   3. Coronado; 946-11 Super Kote 5000 Commercial Latex Block Filler: Applied at a dry film thickness of not less than 8.4 mils.
   4. ICI Dulux Paints; Bloxfil 4000-1000 Interior/Exterior Heavy Duty Acrylic Block Filler: Applied at a dry film thickness of not less than 7.0 to 14.5 mils.
   5. Kelly-Moore; 521 Fill and Prime Acrylic Block Filler: Applied at a dry film thickness of not less than 10.0 mils.
   6. Pittsburgh Paints; 6-7 SpeedHide Interior/Exterior Masonry Latex Block Filler: Applied at a dry film thickness of not less than 6.0 to 12.5 mils.
   7. Sherwin-Williams; PrepRite Interior/Exterior Block Filler B25W25: Applied at a dry film thickness of not less than 8.0 mils.

2.04 EXTERIOR PRIMERS

A. Exterior Ferrous-Metal Primer: Factory-formulated rust-inhibitive metal primer for exterior application.
   1. Sherwin-Williams; Pro-Cryl Universal Primer B66-310 Series: Applied at a dry film thickness of not less than 3.0 mils.

B. Exterior Galvanized Metal Primer: Factory-formulated galvanized metal primer for exterior application.
   1. Sherwin-Williams; Pro-Cryl Universal Primer B66-310 Series: Applied at a dry film thickness of not less than 3.0 mils.

C. Exterior Primer for existing ceramic coated sheet metal: Sherwin-Williams B51- 450 Interior/Exterior Multi-Purpose Latex "Adhesion Primer", or approved equal. Applied at a dry film thickness of 1.4 mils.
   1. Adhesion Primer must be topcoated within 14 days of primer application.

D. Exterior Primer for Wood without knots: Sherwin-Williams Exterior Latex Wood Primer B42W8041. Applied at dry film thickness of not less than 1.4 mils.

E. Exterior Primer for Wood containing knots: Sherwin-Williams Exterior Oil-Based Wood Primer Y24W8020. Applied at at dry film thickness of not less than 2.3 mils.

F. Exterior Primer for Concrete and Fiber Cement Siding (Hardi Board): Loxon Concrete & Masonry Primer B24W8300: Applied at a dry film thickness of not less than 3.0 mils.

G. Exterior Primer for Drywall: Sherwin-Williams B51- 450 Interior/Exterior Multi-Purpose Latex "Adhesion Primer", or approved equal. Applied at a dry film thickness of 1.4 mils.

H. Exterior Architectural PVC, Plastic, or Fiberglass: Sherwin-Williams B51- 450 Interior/Exterior Multi-Purpose Latex "Adhesion Primer", or approved equal. Applied at a dry film thickness of 1.4 mils.

2.05 INTERIOR PRIMERS

A. Interior Concrete Primer (Walls and Ceilings, Poured Concrete, Unglazed Brick, Cement Board, Tilt-Up, Cast-In-Place): Factory-formulated alkali-resistant acrylic-latex interior primer for interior application.
   1. Basis of Design: Subject to compliance with requirements, provide the following products, or approved comparable products by another manufacturer:
   2. Latex Systems:
      a. Eg-Shel / Satin Finish:
         1) Eg-Shel/Satin Finish: Sherwin Williams; Loxon Acrylic Masonry Primer, A24W8300 (8 mils wet, 3.2 mils dry).

B. Interior Masonry Primer: 100% acrylic-emulsion conditioner for interior application only, to bond light chalk to the surface of existing brick & CMU.
   1. Basis of Design: Subject to compliance with requirements, provide the following products, or approved comparable products by another manufacturer:
   2. Sherwin-Williams; Loxon Conditioner Masonry Primer A24-1100 Series: Applied at a dry film thickness per manufacturer's recommendation.
   3. No substitutions

C. Drywall (Walls, Ceilings, Gypsum Board, Plaster Board and similar items)
   1. Basis of Design: Subject to compliance with requirements, provide the following products, or approved comparable products by another manufacturer:
   2. Latex Systems:
      a. Eg-Shel / Satin Finish (Low Odor - Zero VOC):
         1) Sherwin Williams; Harmony Low Odor Interior Latex Primer, B11 (4 mils wet, 1.3 mils dry per

D. Interior Wood Primer for Full-Gloss Alkyd-Enamel Finishes: Factory-formulated alkyd- or acrylic-latex-based interior wood primer.
   1. Basis of Design: Subject to compliance with requirements, provide the following products, or approved comparable products by another manufacturer:
   2. Sherwin-Williams; Premium Wall and Wood Interior Latex Primer B28W8111 Series: Applied at a dry film thickness of not less than 1.8 mils.

E. Interior Steel Primer (Structural Steel Columns, Joists, Trusses, Beams, Miscellaneous and Ornamental Iron, Structural Iron, and Ferrous Metal):
   1. Basis of Design: Subject to compliance with requirements, provide the following products, or approved comparable products by another manufacturer:
   2. Latex Systems:
      a. Semi-Gloss Finish:

1) Sherwin-Williams Pro Industrial Pro-Cryl Primer, B66-310 Series (2-4 mils dry).

3. Alkyd Systems:
   a. Semi-Gloss Water Base Finish:
      1) Sherwin-Williams Pro Industrial Pro-Cryl Primer, B66-310 Series (2.0 - 4.0 mils dry per coat).
   b. Semi-Gloss Low VOC Solvent Base Finish:
      1) Sherwin-Williams Pro Industrial Pro-Cryl Primer, B66-310 Series (2-4 mils dry).
4. Dryfall Waterborne Topcoats:
   a. Semi-Gloss Finish:
      1) Sherwin-Williams Pro Industrial Pro-Cryl Primer, B66-310 Series (2-4 mils dry).
   b. Eg-Shel Finish:
      1) Sherwin-Williams Pro Industrial Pro-Cryl Primer, B66-310 Series (2-4 mils dry).

F. Interior Zinc-Coated Metal Primer: Factory-formulated galvanized metal primer.
1. Basis of Design: Subject to compliance with requirements, provide the following products, or approved comparable products by another manufacturer:
2. Latex Systems:
   a. Semi-Gloss Finish:
      1) Sherwin-Williams Pro-Cryl Universal Primer B66-310 Series: Applied at a dry film thickness of not less than 3.0 mils.

2.06 EXTERIOR FINISH COATS

A. Metal: Aluminum, Galvanized.
1. Basis of Design: Subject to compliance with requirements, provide the following products, or approved comparable products by another manufacturer:
2. Latex Systems:
   a. Semi-Gloss Finish:
      1) 1st Coat: Sherwin-Williams Metalatex Acrylic Semi-Gloss, B42 Series.
      2) 2nd Coat: Sherwin-Williams Metalatex Acrylic Semi-Gloss, B42 Series (4 mils wet, 1.5 mils dry per coat).

B. Metal: Misc. Iron, Ornamental Iron, Structural Iron and Steel, Ferrous Metal.
1. Basis of Design: Subject to compliance with requirements, provide the following products, or approved comparable products by another manufacturer:
2. Latex Systems:
   a. Semi-Gloss Finish:
      1) 1st Coat: Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, B66-310 Series (5-10 mils wet, 2-4 mils dry).
      2) 2nd Coat: Sherwin-Williams Metalatex Acrylic Semi-Gloss, B42 Series.
      3) 3rd Coat: Sherwin-Williams Metalatex Acrylic Semi-Gloss, B42 Series (4 mils wet, 1.5mils dry per coat).

C. Exterior Textured Coating: Sherwin-Williams Ultra Crete Medium Textured Coating, A44W811. Applied at 50-80 sq. ft/gal.

D. Exterior Metal Canopy Semi-Gloss Sherwin-Williams SprayLastic Exterior Semi-Gloss Waterborne Dryfall, B42W17/B42T17. Applied at a dry film thickness of not less than 2.0 mils.

E. Exterior Stained Wood: Siding, Trim, Shutters, Sahses, Hardboard-Bare/Primed:
1. Semi-Transparent:

a. 1st Coat: Sherwin-Williams WoodScapes Exterior Polyurethane Semi-Transparent Stain, A15T5.
b. 2nd Coat: Sherwin-Williams WoodScapes Exterior Polyurethane Semi-Transparent Stain, A15T5 (100-350 sq. ft./gal.).

2. Solid Color:
a. 1st Coat: Sherwin-Williams WoodScapes Solid Color Stain, A15 Series.
b. 2nd Coat: Sherwin-Williams WoodScapes Solid Color Stain, A15 Series (200-400 sq. ft./gal).

F. Concrete: Concrete Floors, Patios, Porches, Steps and Platforms.
1. Basis of Design: Subject to compliance with requirements, provide the following products, or approved comparable products by another manufacturer:
2. Acrylic System Water-Based:
a. Floor Finish:
1) 1st Coat: Sherwin-Williams Porch and Floor Enamel, A32-Series.
2) 2nd Coat: Sherwin-Williams Porch and Floor Enamel, A32-Series (4 mils wet; 1.4 mils dry per coat).

2.07 INTERIOR FINISH COATS

A. Interior Flat Acrylic Paint: Factory-formulated flat acrylic-emulsion latex paint for interior application: ProMar 200 Zero VOC Interior Latex Flat. Applied to a dry film thickness of not less than 1.6 mils.

B. Interior Low-Luster Acrylic Enamel: Factory-formulated eggshell acrylic-latex interior enamel: Promar 200 Zero VOC Interior Eg-Shel. Applied to a dry film thickness of not less than 1.7 mils.

C. Interior Semi-Gloss Acrylic Enamel: Factory-formulated semigloss acrylic-latex enamel for interior application.
1. Benjamin Moore; Moorcraft Super Spec Latex Semi-Gloss Enamel No. 276: Applied at a dry film thickness of not less than 1.2 mils.
2. Coronado; 32-Line Super Kote 5000 Latex Semi-Gloss Enamel: Applied at a dry film thickness of not less than 1.3 mils.
3. ICI Dulux Paints; 1406-XXXX Dulux Professional Acrylic Semi-Gloss Interior Wall & Trim Enamel: Applied at a dry film thickness of not less than 1.5 mils.
4. Kelly-Moore; 1649 Acrylic-Latex Semi-Gloss Enamel: Applied at a dry film thickness of not less than 1.7 mils.
5. Pittsburgh Paints; 6-500 Series SpeedHide Interior Semi-Gloss Latex: Applied at a dry film thickness of not less than 1.0 mil.
6. Sherwin-Williams; ProMar 200 Zero VOC Interior Latex Semi-Gloss Enamel B31-2600 Series: Applied at a dry film thickness of not less than 1.6 mils.

D. Interior Full-Gloss Acrylic Enamel: Factory-formulated full-gloss acrylic-latex interior enamel.
1. Basis of Design: Subject to compliance with requirements, provide the following products, or approved comparable products by another manufacturer:
2. Sherwin-Williams; Solo 100% Acrylic Interior/Exterior Gloss: Applied at a dry film thickness of not less than 1.6 mils.

E. Interior Full-Gloss Alkyd Enamel for Wood and Metal Surfaces: Factory-formulated full-gloss alkyd interior enamel.
1. Basis of Design: Subject to compliance with requirements, provide the following products, or approved comparable products by another manufacturer:
2. Sherwin-Williams; ProMar 200 Alkyd Gloss Enamel B35-200 Series: Applied at a dry film thickness of not less than 1.5 mils.

F. Interior Precatalysed Water-Based Epoxy:
   1. Basis of Design: Subject to compliance with requirements, provide the following products, or approved comparable products by another manufacturer:
   2. Sherwin-Williams; Pro Industrial Pre-Catalysed Water-based Epoxy K45-150 Series (Egg-shell): Applied at a dry film thickness of not less than 1.5 mils.
   3. To be installed at (previously painted) interior existing brick and CMU surfaces; and interior plaster surfaces of exterior walls.

G. Drywall (Walls, Ceilings, Gypsum Board, Plaster Board and similar items):
   1. Basis of Design: Subject to compliance with requirements, provide the following products, or approved comparable products by another manufacturer:
   2. Latex Systems:
      a. Eg-Shel / Satin Finish (Low Odor - Zero VOC):
         1) 1st Coat: Sherwin Williams; Harmony Low Odor Interior Latex Eg-Shel, B9 Series
         2) 2nd Coat: Sherwin Williams; Harmony Low Odor Interior Latex Eg-Shel, B9 Series (4 mils wet, 1.8 mils dry per coat).

H. Interior Concrete (Walls and Ceilings, Poured Concrete, Unglazed Brick, Cement Board, Tilt-Up, Cast-In-Place).
   1. Basis of Design: Subject to compliance with requirements, provide the following products, or approved comparable products by another manufacturer:
   2. Latex Systems:
      a. Eg-Shel / Satin Finish:
         1) 1nd Coat: Sherwin Williams; ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series.
         2) 2rd Coat: Sherwin Williams; ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series (4 mils wet, 1.6 mils dry per coat).

I. Interior Galvanized Metal: Basis of Design: Subject to compliance with requirements, provide the following products, or approved comparable products by another manufacturer:
   1. Basis of Design: Subject to compliance with requirements, provide the following products, or approved comparable products by another manufacturer:
   2. Latex Systems:
      a. Semi-Gloss:
         1) 1nd Coat: Sherwin Williams; ProGreen 200 Interior Latex Semi-Gloss, B31-600 Series.
         2) 2rd Coat: Sherwin Williams; ProGreen 200 Interior Latex Semi-Gloss, B31-600 Series (4 mils wet, 1.6 mils dry per coat).
   3. Dryfall Waterborne Topcoats (for Galvanized Steel Decking):
      a. Semi-Gloss:
         1) 1st Coat: Sherwin Williams; Low VOC Waterborne Acrylic Dryfall, B42W83.
         2) 2nd Coat: Sherwin Williams; Low VOC Waterborne Acrylic Dryfall, B42W83 (11 mils wet, 4.5 mils dry per coat).
      b. Eg-Shel Finish:
         1) 1st Coat: Sherwin Williams; Low VOC Waterborne Acrylic Dryfall, B42W82.
         2) 2nd Coat: Sherwin Williams; Low VOC Waterborne Acrylic Dryfall, B42W82 (11 mils wet, 4.5 mils dry per coat).

J. Interior Metal (Structural Steel Columns, Joists, Trusses, Beams, Miscellaneous and Ornamental Iron, Structural Iron, and Ferrous Metal):
   1. Basis of Design: Subject to compliance with requirements, provide the following products, or approved comparable products by another manufacturer:
   2. Latex Systems:

a. Semi-Gloss Finish:
1) 1st Coat: Sherwin Williams; ProGreen 200 Interior Latex Semi-Gloss, B31-600 Series.
2) 2nd Coat: Sherwin Williams; ProGreen 200 Interior Latex Semi-Gloss, B31-600 Series (4 mils wet, 1.6 mils dry per coat).

3. Alkyd Systems:
a. Semi-Gloss Water Base Finish:
1) 1st Coat: Sherwin Williams; ProMar 200 Waterbased Acrylic/Alkyd Semi-Gloss, B34-8200 Series.
2) 2nd Coat: Sherwin Williams; ProMar 200 Waterbased Acrylic/Alkyd Semi-Gloss, B34-8200 Series (4 mils wet, 1.7 mils dry per coat).
b. Semi-Gloss Low VOC Solvent Base Finish:
1) 1st Coat: Sherwin Williams; ProClassic XP Interior Alkyd Semi-Gloss, B34W551.
2) 2nd Coat: Sherwin Williams; ProClassic XP Interior Alkyd Semi-Gloss, B34W551 (4 mils wet, 3.7 mils dry per coat).

4. Dryfall Waterborne Topcoats:
a. Semi-Gloss Finish:
1) Sherwin Williams; Low VOC Waterborne Acrylic Dryfall, B42W83.
b. Eg-Shel Finish:
1) Sherwin Williams; Low VOC Waterborne Acrylic Dryfall, B42W82.

K. Wood: Walls, Ceilings, Doors, Trim.
1. Basis of Design: Subject to compliance with requirements, provide the following products, or approved comparable products by another manufacturer:
2. Latex Systems:
a. Semi-Gloss Finish:
1) 1st Coat: S-W PrepRite ProBlock Latex. B51 Series (4 mils wet, 1.4 mils dry).
2) 2nd Coat: S-W ProMar 200 Latex Semi-Gloss, B31-2200 Series.
3) 3rd Coat: S-W ProMar 200 Latex Semi-Gloss, B31-2200 Series (4 mils wet, 1.3 mils dry per coat).
b. Semi-Gloss (Low Odor - Low VOC):
1) 1st Coat: S-W PrepRite ProBlock Latex. B51 Series (4 mils wet, 1.4 mils dry).
2) 2nd Coat: S-W ProGreen 200 Interior Latex Semi-Gloss, B31-600 Series.
3) 3rd Coat: S-W ProGreen 200 Interior Latex Semi-Gloss, B31-600 Series (4 mils wet, 1.6 mils dry per coat).

3. Stain and Varnish:
a. Clear Finish:
1) 1st Coat: S-W Wood Classics 250 VOC Oil Stain A49-800 Series.
2) 2nd Coat: S-W Wood Classics Waterborne Polyurethane Varnish.
3) 3rd Coat: S-W Wood Classics Waterborne Polyurethane Varnish (4 mils wet, 1.0 mil dry per coat).
a) Sheen: Satin.

2.08 INTERIOR WOOD STAINS AND VARNISHES

A. Interior Oil Stain: Sherwin-Williams Wood Classics Oil Stain A49-200 Series, or comparable.
1. Color as selected by architect.

B. Clear Sanding Sealer: Factory-formulated fast-drying alkyd-based clear wood sealer applied at spreading rate recommended by manufacturer. Use sanding sealer as may be required to reduce quantity of stain soaked in by porous woods such as cedar, and/or to achieve approved color and effect as approved by sample and mockup reviews specified in other sections.

1. Coronado; 81-10 Dual Seal.
2. ICI Dulux Paints; 1902-0000 WoodPride Interior Satin Polyurethane Varnish.
3. Kelly-Moore; 2164 E Z Sand Alkyd Q. D. Sealer.
4. Pittsburgh Paints; 6-10 SpeedHide Quick-Drying Interior Sanding Wood Sealer and Finish.
5. Sherwin-Williams; Wood Classics Fast Dry Sanding Sealer B26V43.

C. Interior Alkyd- or Polyurethane-Based Clear Satin Varnish: Factory-formulated alkyd- or polyurethane-based clear varnish.
1. Coronado; 67-100 Polyurethane Liquid Plastic Satin Varnish.
2. ICI Dulux Paints; 1902-0000 WoodPride Interior Satin Polyurethane Varnish.
3. Kelly-Moore; 2050 Kel--Aqua Stain Base.
4. Pittsburgh Paints; 77-7 Rez Varnish, Interior Satin Oil Clear.
5. Sherwin-Williams; Wood Classics Fast Dry Oil Varnish, Satin A66-300 Series.

2.09 MISCELLANEOUS PAINT PRODUCTS

A. Epoxy: Two component epoxy coating shall be Sherwin-William's "Tile-Clad High Solids Epoxy #B62Z Series, or approved equal.

B. Semi-transparent water repellent wood preservative stain shall be Olympic's Semi-Transparent Oil Base Stain, or equal.

C. Other materials such as linseed oil, turpentine and shellacs shall be pure and of highest quality.

D. Acrylic Concrete Coating: Exterior concrete coating shall be "Thorocoat" 100% acrylic, textured coating as manufactured by Thoro System Products, Miami, Florida. Color as selected by Architect.

E. Concrete Floor Sealer: Exposed concrete floor slabs with smooth troweled finish: One coat flood-applied, hardener/densifier. Chemical reactive silicate / siliconate formulation that enhances sheen level of troweled concrete and is designed to mainatin or increase sheen level over time with normal wear. Provide one of the following or approved equal product by another Manufacturer:
a. Euclid Chemical Company; "Euco Diamond Hard", www.euclidchemical.com.
b. CureCrete Chemical Company; "Ashford Formula", www.ashfordformula.com.
c. Dayton Superior; "Sure-Hard Densifier J17", www.daytonchemical.com.
d. L&M Construction Chemicals: "Seal Hard", www.lmmc.com.

F. Epoxy Coating: Interior concrete block to receive coating shall be filled using a modified epoxy masonry filler equal to Tnemec's No. 54-660 and receive epoxy-polyomide coating equal to Tnemec's Series 66 HiBuild Epoxoline.

G. Exterior Concrete Block Protective Coating: One part, water based, cross linked copolymer coating shall be Rainguard Products Company's "Vandl-Guard Graffiti Resistant Coating", or approved equal.

H. Concrete Block Sealer: Waterproofing clear penetrating sealer shall be "Rainguard Micro-Seal" as manufactured by Rainguard Products Co., or approved equal. Install at coverage rate determined adequate by manufacturer's representative.

I. Sealer Thinner: Sonneborne's "Reducer 990", or approved equal.

J. Wood Sealer: Penetrating water-repelling sealer shall be Olympic, "Water Guard".

K. Waterbased Epoxy: Catalyzed epoxy meeting requirements of ASTM D3730, equal to Sherwin Williams B67 Series.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application.
   1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
   2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
   1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

3.02 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.
   1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.
   1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
   1. Provide barrier coats over incompatible primers, or remove and re-prime.
   2. Cementitious and Masonry Materials: Prepare brick, concrete, concrete unit masonry, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
      a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
      b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
   3. Wood: Clean new or existing surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view down to consistent substrate for intended finish. Ensure smooth surface remains and remove all residual dust.
      a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
      b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, trim, rails, doors, frames and windows.
      c. If transparent finish is required, backprime with spar varnish.

d. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.

4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
   a. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
   b. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
5. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
   1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
   2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
   3. Use only thinners approved by paint manufacturer and only within recommended limits.

E. Concrete floor surfaces to remain exposed shall be cleaned and properly acid etched per floor sealer manufacturer's instructions. Fill and patch holes, crevices, cracks, etc.. Remove any paint, soil, loose material and dust. Remove oil or grease with a hot TSP solution and rinse thoroughly. Floor to be completely dry prior to etching with muriatic acid and water solution.

3.03 APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
   1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
   2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
   3. Provide finish coats that are compatible with primers used.
   4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
   5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
   6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
   7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
   8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
   9. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
   10. Sand lightly between each succeeding enamel or varnish coat.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
   1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
   2. Omit primer over metal surfaces that have been shop primed and touchup painted.
   3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
   4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
   1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
   2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
   3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.

E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.

F. Mechanical items to be painted include, but are not limited to, the following:
   1. Uninsulated metal piping.
   2. Uninsulated plastic piping.
   3. Pipe hangers and supports.
   4. Tanks that do not have factory-applied final finishes.
   5. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
   6. Duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.
   7. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
   8. New rooftop gas piping.
   9. All existing and new exterior conduit, gas, water and similar piping at face of exterior walls.

G. Electrical items to be painted include, but are not limited to, the following:
   1. Switchgear.
   2. Panelboards.
   3. Electrical equipment that is indicated to have a factory-primed finish for field painting.

H. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

I. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.

J. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

K. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
   1. Provide satin finish for final coats.

L. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.

M. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.04 CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.
   1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.05 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.
   1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces prior to final inspection. Comply with procedures specified in PDCA-P1.

3.06 EXTERIOR PAINT SCHEDULE

A. Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.
   1. Full-Gloss Acrylic-Enamel Finish: Two finish coats over a rust-inhibitive primer.
      a. Primer: Exterior ferrous-metal primer.
      b. Finish Coats: Exterior full-gloss acrylic enamel for ferrous and other metals.

B. Zinc-Coated Metal: Provide the following finish systems over exterior zinc-coated metal surfaces:
   1. Full-Gloss Acrylic-Enamel Finish: Two finish coats over a galvanized metal primer.
      a. Primer: Exterior galvanized metal primer.
      b. Finish Coats: Exterior full-gloss acrylic enamel for ferrous and other metals.

C. Wood Doors: Provide the following paint finish systems over wood surfaces:
   1. Gloss Latex Finish: Two finish coats over a wood primer.
      a. Primer: latex wood primer.
      b. Finish Coats: gloss latex for wood surfaces.

D. Cement Fiber Board: Provide the following paint finish systems over cement fiber board surfaces:
   1. Latex Satin Finish: Two finish coats over primer.
      a. Primer: Loxon concrete primer.
      b. Finish Coats: latex satin finish.

3.07 INTERIOR PAINT SCHEDULE

A. New Concrete Unit Masonry: Provide the following finish systems over new interior concrete masonry:
   1. Semigloss Acrylic-Enamel Finish: Two finish coats over a block filler.
      a. Block Filler: Concrete unit masonry block filler.
      b. Finish Coats: Interior semigloss acrylic enamel.

B. Existing Concrete Unit Masonry or Brick: Provide the following finish systems over existing (previously painted) interior concrete masonry or brick:
   1. Egg shell Epoxy Finish: Two finish coats over primer / block filler.
      a. Primer / Block Filler: Acrylic-emulsion conditioner.
      b. Finish Coats: Pre-catalysed water-based epoxy.

C. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:
   1. Semigloss Acrylic-Enamel Finish: (typical) Two finish coats over a primer.
      a. Primer: Interior gypsum board primer.
      b. Finish Coats: Interior semigloss acrylic enamel.
   2. Full Gloss Epoxy Finish: (at Kitchen Food Prep, Dry Storage, receiving, and serving areas, and at locker rooms, shower rooms, and restrooms): Two finish coats over primer.
      a. Primer: Interior gypsum board primer.
      b. Finish Coats: Interior polyester epoxy.

D. Plaster: Provide the following finish systems over new interior plaster surfaces:
   1. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.
      a. Primer: Interior plaster primer.
      b. Finish Coats: Interior semigloss acrylic enamel.
   2. Full Gloss Epoxy Finish: (at Kitchen Food Prep, Dry Storage, receiving, and serving areas, and at locker rooms, shower rooms, and restrooms): Two finish coats over primer.
      a. Primer: Interior gypsum board primer.
      b. Finish Coats: Interior polyester epoxy.

E. Existing Plaster: Provide the following finish systems over existing (previously painted) interior plaster surface of exterior walls:
   1. Egg shell Epoxy Finish: Two finish coats over primer.
      a. Primer: High build latex wall primer.
      b. Finish Coats: Pre-catalysed water-based epoxy.

F. Wood and Hardboard: Provide the following paint finish systems over interior wood surfaces:
   1. Full-Gloss Alkyd-Enamel Finish: Two finish coats over a wood primer.
      a. Primer: Interior wood primer for full-gloss alkyd-enamel finishes.
      b. Finish Coats: Interior full-gloss alkyd enamel for wood and metal surfaces.

G. Ferrous Metal: Provide the following finish systems over ferrous metal:
   1. Full-Gloss Acrylic-Enamel Finish: Two finish coats over a primer.
      a. Primer: Interior ferrous-metal primer.
      b. Finish Coats: Interior full-gloss acrylic enamel.

H. Zinc-Coated Metal: Provide the following finish systems over interior zinc-coated metal surfaces:

1. Full-Gloss Acrylic-Enamel Finish: Two finish coats over a primer.
    a. Primer: Interior zinc-coated metal primer.
    b. Finish Coats: Interior full-gloss acrylic enamel.

I. All-Service Jacket over Insulation: Provide the following finish system on cotton or canvas insulation covering:
    1. Flat Acrylic Finish: Two finish coats. Add fungicidal agent to render fabric mildew proof.
        a. Finish Coats: Interior flat latex-emulsion size.

J. Interior Concrete Floors: Provide the following:
    1. 1st coat - Sealer / Reducer (400 SF/gal.)
    2. 2nd coat - Sealer / Reducer (600 SF/gal.)
        a. Exposed Concrete Finished Floors.

3.08 INTERIOR STAIN AND NATURAL-FINISH WOODWORK SCHEDULE

A. Natural-Finish Woodwork: Provide the following natural finishes over new interior woodwork not specified as shop finished:
    1. Alkyd-Based Satin-Varnish Finish: Two finish coats of alkyd-based clear satin varnish over a sanding sealer. Provide wood filler on open-grain wood before applying first varnish coat.
        a. Sealer Coat: Clear sanding sealer.
        b. Finish Coats: Interior alkyd- or polyurethane-based clear satin varnish.

END OF SECTION 09 91 00

SECTION 10 26 14 - WALL AND CORNER PROTECTION

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. Work includes all labor, materials and services necessary to furnish and install all wall and corner guards as shown on drawings and as herein specified.

B. Related Sections include the following:
   1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to the work of this section.
   2. Division 7 Section: Caulking & Sealants
   3. Division 9 Section: Gypsum Wallboard
   4. Division 9 Section: Painting

1.03 SUBMITTALS

A. Submit shop drawings, product data and installation instructions.

B. Product Data: Indicate physical dimensions, features, and anchorage details.

C. Provide samples of manufacturer's standard color range.
   1. Submit two sections of corner guard, 24 inch long, illustrating component design, configuration, color and finish.

PART 2 - PRODUCTS

2.01 WALL GUARDS

A. Surface-Mounted Corner Guards: Shall be Inpro Corp., EnviroGT, Stainless Steel, Tape-On, or approved equal by Construction Specialties or Pawling Corp.
   1. One-piece unit without splices, installed with low VOC polyurethane based construction adhesive.
      a. Material:
         1) Type 304 stainless steel, Thickness: 18 gage, 0.05 inch, No. 4 finish.
         2) Reformulated PETG with Biopolymer Blend, .080” (2mm) thickness.
      b. Width of Wings: 3-1/2 inches.
      c. Style: 90 degree corners.
      d. Height: 36 inch.

B. Fabrication
   1. Fabricate from one aluminum sheet into one single piece.
   2. Remove burrs.
   3. 1/8 inch radius corner

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install at heights indicated on the drawings.

B. Install with top aligned as shown on drawings, unless otherwise directed by Architect. Where corner guard top elevation is not shown on drawings, corner guards shall be 42", with bottom edge mounted at top of wall base.

C. Install wall and corner guards plumb, level and rigidly secure in place in accordance with manufacturer's instructions.

D. Mounting retainer shall be set a maximum of 18" on centers.

E. Retainers for flush-mounted corner guards shall be installed prior to application of drywall.

F. Vinyl acrylic extrusions shall be installed after painting or wall covering has been completed.

END OF SECTION 10 26 14

SECTION 12 48 13 - ENTRANCE MATS AND FRAMES

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. Complete recessed floor mat system, installed flush with adjacent flooring systems. Coordinate with other trades as required.

B. Related Sections include the following:
   1. Division 3 Section: Cast-In-Place Concrete
   2. Division 3 Section: Self-Leveling Underlayment, for leveling installed under mats.
   3. Division 09 "Flooring" Sections, for coordination of recess depth and installation requirements for flush installation with adjacent flooring systems.

1.03 QUALITY ASSURANCE

A. Entrance Mat Manufacturer: Except as otherwise indicated, provide entrance mats and accessories by a single manufacturer, Reese Enterprises, Inc., Construction Specialties Inc., J. L. Industries, or other approved equal, for entire project.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's specification and installation instructions for each type of entrance mat. Indicate properties of walk-off surface, component dimensions and recessed frame characteristics and include methods of installation for each type of substrate.

B. Samples: Submit two samples, 12 by 12 inch in size illustrating pattern, color, finish, edging and selected carpet.

C. Shop Drawings: Submit shop drawings for entrance mats. Include full scale sections of typical installations. Provide shop drawings in sufficient detail showing layout of grid and frame specified including details indicating construction relative to materials, direction of traffic, spline locations, profiles, anchors and accessories. Coordinate shop drawing submittal with concrete work shop drawings showing oversized recess for delayed installation of mat frames.
   1. For recessed frames located within a dimensionally restricted area, show dimensions of space within which the frame will be installed.

D. Maintenance Data: Include cleaning instructions, stain removal procedures.

PART 2 - PRODUCTS

2.01 ENTRANCE MAT

A. General: Provide colors/patterns/profiles of materials, including metals and metal finishes, as indicated on drawings or by this specification or, where not indicated, as selected by Architect from manufacturer's standard colors/patterns/profiles. Shop fabricate units of entrance mat work in sizes as indicated. Miter corner joints in framing elements, with hairline joints, or provide prefabricated corner units without joints. Where possible, verify sizes by field measurement prior to shop fabrication.

B. Entrance Floor Grilles and Gratings:
   1. Basis of Design: Subject to compliance with requirements, provide the following products, or approved comparable products by another manufacturer:
      1) Ronick Matting Systems, www.ronick.com PediTred G4 Entrance Mat System
         a) Metal Finish: Clear anodized.
         b) Carpet Insert: Heavy duty carpet insert, color selected from manufacturer's full range of colors.
         c) Frame Type: Recessed Level Base Frame LB.

C. Fabrication
   1. in contact with cementitious materials.
      a. Material:
         1) Type 304 stainless steel, Thickness: 18 gage, 0.05 inch, No. 4 finish.
         2) Reformulated PETG with Biopolymer Blend, .080" (2mm) thickness.
      b. Width of Wings: 3-1/2 inches.
      c. Style: 90 degree corners.
   2. Fabricate mats in single unit sizes; fabricate multiple mats where indicated

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install recessed frames and entrance mats to comply with manufacturer's instructions, at locations indicated and with top of frames and mats in proper relationship to one another and to adjoining finished flooring. Set mat tops at proper height for most effective cleaning action; coordinate top of mat surfaces with doors that swing across mats, to provide under door clearance.

3.02 PROTECTION

A. After completing frame installations, provide temporary filler of plywood or fiber board in foot grille recesses and cover frames with plywood protective flooring.

B. Maintain protection until construction traffic has ended and Project is near Substantial Completion. Clean recessed floor mats of construction dirt and debris just prior to substantial completion.

END OF SECTION 12 48 13

SECTION 12 93 00 - SITE FURNISHINGS AND 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 SUMMARY

A. Section Includes:
   1. Bicycle Racks.
   2. Metal Trash Receptacles.

B. Related Sections include the following:
   1. Division 03 Section - Concrete.
   2. Division 05 Section - Metal Fabrications, for coordination of cast-in dowels not provided by site furnishing manufacturers.
   3. Division 32 Section - Concrete Paving.
   4. Division 32 Section - Irrigation, for coordination with irrigation in planters.
   5. Division 32 Section - Landscaping, for solid block limestone benches.

1.03 QUALITY ASSURANCE

A. Manufacturers: Major components are specified to be by Little Tikes Commercial Play Systems Corp.. Equipment models, components and type is specified to define overall quality. Equipment manufacturer substitutions shall be submitted to the Owner prior to bidding.

B. Supply equipment that conforms to all applicable standards, meets Consumer Product Safety Commission Guidelines, and complies with ADA and Texas Accessibility Standards criteria.

1.04 SUBMITTALS

A. Complete shop drawings, equipment list, installation instructions, and manufacturer's standard brochures based on contract documents submitted to the Architect for review and approval. Include dimensioned site plan locating site furnishings, coordinated with Contractor's field-verified dimensions.

1.05 PROJECT CONDITIONS

A. Contractor shall field measure and verify actual dimensions for layout submitted with shop drawings. Coordinate with related work of precast concrete bollards, stone benches, sidewalks, and unit paving and hardscaping. Coordinate bicycle rack installation requirements with paving installer, including possible need for thickened area of sidewalk paving to receive mounting hardware.

1.06 WARRANTY

A. Manufacturer's standard 1-year warranty against manufacturer defects.

PART 2 - PRODUCTS

2.01 BICYCLE RACKS

A. Heavy-duty ASTM 53, 2.375" o.d. x .154" wall, Schedule 40 steel pipe galvanized after fabrication for direct embedment installation in concrete footing to a depth of 10" with in-ground anchor mounts. Units shall be "Original Cycloops" Model 2170-7, by Columbia Cascade Company or approved equal. Finish shall be powder coated, in color as selected by Architect from Manufacturer's full range.

2.02 METAL TRASH RECEPTACLES

A. Litter Container: Coated steel, dome top container and matching color coated 32 gallon steel liner and top for secured mounting to concrete pad shall be Timber Form's "Renaissance", Model No. 2814-DT-E in standard color "Evergreen" or approved equal.

PART 3 - EXECUTION

3.01 INSPECTION AND COORDINATION

A. Contractor to examine furnishings upon delivery and prior to installation for damage and reject damage material.

B. Field measurements must be verified. Coordinate with adjacent work of other trades. Ensure cast-in anchors and dowels, or other mounting hardware, are located accurately.

C. Coordinate planter installation with irrigation installer. Prepare planters for irrigation by coring holes in bottom of planters as required. Coordinate locations of irrigation riser pipe penetrations with irrigation installer.

D. Prior to beginning new sidewalks or paving work, coordinate thickened paving conditions and attachments as required for furnishing installation, per manufacturer's installation recommendations.

3.02 INSTALLATION

A. Contractor shall install all equipment according to manufacturer's instructions. Equipment installed level, plumb, straight and true to line.

B. Removable trash receptacle liners and trash rings just prior to substantial completion.

C. Take care in handling and installation to avoid damage to surfaces and finishes of site furnishings. Repair minor surface damage in accordance with manufacturer's recommendations. Where surface damage cannot be repaired, replace damaged units.

END OF SECTION 12 93 00

SECTION 22 00 10 - BASIC PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.01 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".

1.02 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.

1.03 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. 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.

1.04 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.

1.05 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.

1.06 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 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.

1.07 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.

1.08 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.

1.09 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.

1.10 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.

1.11 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.

1.12 OPERATING AND MAINTENANCE INSTRUCTIONS

A. The Contractor shall prepare, one hard copy and one electronic copy 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.

1.13 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, and shall include on-site contractor response within 24 hours of initial notification by the Owner.

C. Certain items for equipment shall have additional or extended warranties when so specified.

1.14 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.

1.15 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.

1.16 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.

1.17 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.

1.18 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. Sleeves shall be installed prior to pipe/duct installation.

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.

1.19 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.

1.20 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 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 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.

1.21 PLUMBING SUBMITTALS

A. Refer to the Conditions of the Contract (General and Supplementary) and Division 01 Section: "SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES" for submittal definitions, requirements, and procedures.

B. Submittal of Shop Drawings, product data, and samples will be accepted only when submitted by The Contractor. Data submitted from Subcontractors and material suppliers directly to the Architect/Engineer will not be processed.

C. Submit Shop Drawings, product data, and samples on items indicated in the individual sections.

D. Shop Drawings and submittal 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.

E. 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.

1.22 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

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.

1.23 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.

1.24 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.

1.25 CLEANING

A. Refer to the Division 01 Section: "CLOSEOUT PROCEDURES" for general requirements for final cleaning.

B. Refer to Division 23 Section: "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 daily 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.

1.26 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 -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

   Motor efficiency certification shall be included with Product Submittal Data in accordance with Division 01 of these specifications.
   3. 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.
   4. 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

2.01 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 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.

2.02 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.

2.03 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.

2.04 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. Drain piping
4. Vent piping
5. Electrical bus duct
6. Supply ductwork
7. Return ductwork
8. Chilled water and heating water piping
9. Automatic Fire Protection Sprinkler Piping
10. Domestic hot and cold water piping
11. Electrical conduit

2.05 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 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.

2.06 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.

2.07 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

3.01 INSTALLATION METHODS

A. All pipes shall be concealed in pipe chases, walls, furred spaces, or above the building, 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.

3.02 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.

3.03 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.

3.04 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. 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.

3.05 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. **The contractor shall coordinate with the Owner-provided Test and Balance Contractor as required, and shall make any necessary adjustments required to ensure a fully functional system to the satisfaction of the Owner.**

F. 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.

3.06 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.

3.07 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.

3.08 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".

3.09 TEMPORARY FACILITIES

A. Unless noted otherwise in the Supplementary General Conditions; provide temporary facilities.

3.10 EQUIPMENT INSTALLATION REQUIREMENTS

A. All plumbing equipment shall be furnished and installed complete and ready for use.

3.11 EXCAVATION, BACKFILLING AND COMPACTION

A. Provide excavation, backfilling and compaction in accordance with requirements of Division 31.

3.12 OWNER FURNISHED EQUIPMENT

A. The Contractor’s responsibility shall include receiving and installing all Owner-furnished equipment.

END OF SECTION 22 00 10

SECTION 22 05 06 - PLUMBING DEMOLITION

PART 1 - GENERAL

1.01 SUMMARY

A. Demolition of:
   1. Plumbing fixtures and trim, specialties, equipment and associated piping.
   2. Hanger and support devices.
   3. 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.

1.02 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.

1.03 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

3.01 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.

3.02 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.

3.03 DEMOLITION

A. Perform demolition in accordance with all requirements of the Owner.

3.04 DISPOSITION OF MATERIALS

A. Dispose of all demolition items and materials in a legal off-site location.

3.05 CLEANING

A. Section 22 00 10 "BASIC PLUMBING REQUIREMENTS".

3.06 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.

3.07 SCHEDULING

A. Schedule demolition in strict compliance with the Owner's instructions.

3.08 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 22 05 06

SECTION 22 05 12 - PLUMBING AND ELECTRICAL COORDINATION

PART 1 - GENERAL

1.01 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.

1.02 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 21 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.

1.03 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
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

	ITEM	FURNISHED UNDER DIVISION	INSTALLED UNDER DIVISION	WIRED AND CONNECTED UNDER DIVISION
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
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

	ITEM	FURNISHED UNDER DIVISION	INSTALLED UNDER DIVISION	WIRED AND CONNECTED UNDER DIVISION
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

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. Electrical bus duct
      f. Supply ductwork
      g. Return ductwork
      h. Chilled water and heating water piping
      i. Automatic Fire Protection Sprinkler Piping
      j. Domestic hot and cold water piping
      k. 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 22 05 12

SECTION 22 05 29 - PLUMBING SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.01 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.

C. Supports and anchors furnished as part of factory-fabricated equipment are specified as part of equipment assembly in other Division 22 sections.

1.02 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.

1.03 SUBMITTALS

A. Submit product data and maintenance data 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

2.01 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. **General: All piping hangers within wall chases shall be galvanized.**

C. Adjustable Steel Clevis Hangers: MSS Type 1.

D. Yoke Type Pipe Clamps: MSS Type 2.

E. Adjustable Band Hangers: MSS Type 9.

F. Pipe Stanchion Saddles: MSS Type 37, including steel pipe base support and cast-iron floor flange.

2.02 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.

2.03 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.

2.04 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.

2.05 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

2.06 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.

2.07 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.

2.08 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.

2.09 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)

2.10 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

3.01 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.

3.02 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 Architect for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

3.03 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.

3.04 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.

3.05 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.

3.06 CONCRETE HOUSEKEEPING BASES

A. Concrete housekeeping bases will be provided as work of Division 03. Furnish to Contractor, scaled layouts of all required bases, with dimensions of bases, and location to column centerlines. Furnish templates, anchor bolts, and accessories, necessary for base construction.

B. 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.

3.07 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 22 05 29

SECTION 22 05 53 - PLUMBING IDENTIFICATION

PART 1 - GENERAL

1.01 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. Engraved Plastic-Laminate Signs.

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.

1.02 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.

1.03 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

2.01 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.
   5. MSI - Marking Services, Inc.

2.02 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.

2.03 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. Insulation: Furnish 1 in. thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on un-insulated pipes subjected to fluid temperatures of 125°F (52°C) or greater. Cut length to extend 2 in. beyond each end of plastic pipe marker.

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.

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. 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.

2.04 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., except as otherwise indicated.

C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.05 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.

2.06 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

3.01 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.

3.02 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, and within 5 feet of a 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 25 ft. along each piping run, except reduce spacing to 25 ft. in congested areas of piping and equipment.
7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

C. Piping Identification:
   1. Coordinate Piping System identification colors with Owner prior to installation.

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

3.03 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.

3.04 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 22 05 53

SECTION 22 07 16 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.01 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. Calcium Silicate.
      c. Flexible Unicellular.

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.

D. Refer to Section 22 05 53 - PLUMBING IDENTIFICATION for installation of identification devices for piping, ductwork, and equipment; not work of this section.

1.02 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 (NFPA 255) 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.

1.03 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.

B. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in maintenance manual.

1.04 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

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
   1. Armacell.
   2. Manson.
   3. Knauf Fiber Glass.
   4. Johns Manville Products Corp.
   5. Owens-Corning Fiberglass Corp.

2.02 PIPING INSULATION MATERIALS

A. Fiberglass Piping Insulation: ASTM C 547, Class 1 unless otherwise indicated.

B. Calcium Silicate Piping Insulation: ASTM C 553, Type I.

C. Flexible Unicellular Piping Insulation: ASTM C 534, Type I.

D. Jackets for Piping Insulation: ASTM C 921, 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.
   2. Encase exterior piping insulation with aluminum jacket with weather-proof construction.

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.

2.03 METAL PROTECTIVE JACKET

A. Sheet aluminum: ASTM B209, 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. Seams shall be on bottom edge of piping.

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. A two in. overlap is required at longitudinal and circumferential joints.

PART 3 - EXECUTION

3.01 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 T.I.M.A.

3.02 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. Interior horizontal above-ground storm water piping from roof drains.
      b. Condensate drains from HVAC units, refrigerated equipment, etc., including traps and lateral lines concealed above ceilings.
   2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:
      a. Flexible Unicellular: 1 in. thickness.

3.03 EQUIPMENT INSULATION

A. Cold Equipment (Below Ambient Temperature):
   1. Application Requirements: Insulate the following cold equipment:
      a. Roof drain and overflow drain bodies.
      b. Floor drain bodies, traps, and 2 ft. 0 in. of drain piping located in floors above grade receiving condensate below ambient temperature.
   2. Insulate each item of equipment specified above with one of the following types and thicknesses of insulation:
      a. Fiberglass: 2 in. thick for surfaces above 35°F (2°C) and 3 in. thick for surfaces 35°F (2°C) and lower.
      b. Flexible Unicellular: 1 in. thick.

3.04 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-barrier 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.

3.05 INSTALLATION OF EQUIPMENT INSULATION

A. General: Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.

B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gapping joints and excessive voids resulting from poor workmanship.

C. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.

D. Do not apply insulation to equipment, breechings, or stacks while hot.

E. Apply insulation using staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.

F. Coat insulated surfaces with layer of insulating cement, trowelled in workmanlike manner, leaving smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.

G. Cover insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least 2 in. Apply over vapor barrier where applicable.

H. Do not insulate boiler manholes, hand-holes, cleanouts, ASME stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.

I. Provide removable insulation sections to cover parts of equipment that must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.

3.06 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 screws, rivets, or 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.

3.07 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.

3.08 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 22 07 16

SECTION 22 10 00 - PLUMBING PIPING

PART 1 - GENERAL

1.01 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. Miscellaneous Drain Lines
   2. Storm drainage system.

1.02 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/AWS D1.1 - Structural Welding Code.

J. AWS D10.12 - Recommended Practices and Procedures for Welding Plain Carbon Steel Pipe.

K. AWS D10.9 - Qualifications and Procedures for Piping and Tubing Welding.

L. AWS B3.0 - Welding Procedure and Performance Qualification.

M. ANSI/AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.

N. ANSI/AWWA C110 - Ductile Iron and Gray Iron Fittings 3 in. through 48 in., for Water and Other Liquids.

O. ANSI/AWWA C111 - Rubber-Gasket Joints for Ductile Iron and Gray-Iron Pressure Pipe and Fittings.

P. ANSI/AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

Q. ASME - Boiler and Pressure Vessel Code.

R. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

S. ASTM A74 - Cast Iron Soil Pipe and Fittings.

T. ASTM A120 - Pipe, Steel, Black and Hot-Dipped Zinc Coated (Galvanized), Welded and Seamless, for Ordinary Uses.

U. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

V. ASTM B88 - Seamless Copper Water Tube.

W. ASTM B306 - Copper Drainage Tube (DWV).

X. ASTM C14 - Concrete Sewer, Storm Drain, and Culvert Pipe.

Y. ASTM C425 - Compression Joints for Vitrified Clay Pipe and Fittings.

Z. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

AA. ASTM C 1540 - Heavy Duty Shielded Hubless Couplings

AB. AWS A5.8 - Brazing Filler Metal.

AC. AWWA C601 - Standard Methods for the Examination of Water and Waste Water.

AD. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.

AE. CISPI 310 - Couplings for Use with Hubless Cast Iron Soil Pipe and Fittings.

AF. NFPA 24 - Installation of private fire service mains and their Appurtenances, latest edition.

AG. NFPA 54 - National Fuel Gas Code, latest edition.

1.03 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.

1.04 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.

1.05 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.

PART 2 - PRODUCTS

2.01 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.

2.02 STORM DRAINAGE PIPING

A. Storm drainage piping, buried beyond 5 ft. of building.
   1. See Division 33.

B. Storm drainage piping, buried within 5 ft. of building.
   1. Cast Iron Pipe & Fittings: ASTM A74 service weight. Joints: Hub-and-spigot, compression type with ASTM C564 neoprene gaskets.
   2. 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. Storm drainage piping, above grade.
   1. Cast Iron Pipe & Fittings: CISPI 301, hubless, service weight. Joints: ASTM C564, neoprene gaskets and stainless steel clamp-and-shield assemblies. Joints over 4 in. shall be Heavy Duty couplings conforming to ASTM C 1540 as manufactured by Husky SD 4000 or Clamp All 125.

2.03 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.

2.04 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

2.05 EXCAVATION, BACKFILLING AND COMPACTING

A. Provide excavation, backfilling and compacting in accordance with Division 31 .

2.06 PIPING SPECIALTIES

A. Provide piping specialties in accordance with Section 22 11 19.

2.07 PLUMBING SUPPORTS AND ANCHORS

A. Provide supports and anchors in accordance with Section 22 05 29.

2.08 PLUMBING METERS AND GAUGES

A. Provide meters and gauges in accordance with Section 22 05 19.

2.09 PLUMBING INSULATION

A. Provide mechanical insulation in accordance with Section 22 07 16.

2.10 PLUMBING IDENTIFICATION

A. Provide mechanical identification of all piping systems and valves in accordance with Section 22 05 53.

PART 3 - EXECUTION

3.01 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. Establish elevations of buried piping outside the building to ensure not less than 3 ft. of cover.

O. Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting. Refer to Division 09, PAINTING.

P. Install piping parallel with or at right angles to walls unless otherwise shown on Drawings.

Q. Conceal piping above ceilings, in walls or chases etc., unless otherwise shown or noted on Drawings.

R. Joints in soft copper piping below slab will not be allowed.

S. Soft copper shall not be routed through areas with exposed ceilings except in mechanical rooms.

T. Bending of rigid piping is not permitted; only ells shall be utilized for a change in direction.

U. Temporarily plug or cap open ends of pipe at the end of each workday.

V. 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.

W. Install bell and spigot pipe with bell end upstream.

X. Trap primer piping shall slope to floor drain at no less than 1/16 in. per ft. Horizontal trap primer piping shall run below floor. Piping in slab is not permitted.

Y. Install vented U-type drain trap on all draw-thru cooling coil drain pans.

Z. All sanitary waste stacks and storm drain down spouts 4 in. diameter and larger with vertical drops over 30 ft. 0 in. shall be provided with joint restraint on the horizontal branch or offset below the vertical drop. Threaded joints, grooved joints or a combination of pipe clamps and tie-rods as required in NFPA 24 shall accomplish joint restraint. Thrust blocks shall accomplish joint restraint below ground as required in NFPA 24. Vertical joint restraint shall be provided from the 90° ell at the bottom of the vertical drop through every joint up to the riser clamp at the floor penetration of the floor above. Horizontal joint restraint shall be provided from that same 90° ell through every joint on the horizontal branch.

AA. 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.

AB. Fuel-gas lines and waste cleanouts shall not be located within an air supply plenum.

AC. 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.

AD. A pressure reducing valve station shall be furnished and installed on incoming domestic cold water lines with pressure exceeding 80 psi. Furnish valve station with separate strainer.

AE. Roof penetrations through metal roofs by the Plumbing or Mechanical Contractor will be required to have written approval by the Roofing Contractor.

3.02 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.

3.03 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.

3.04 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. Tests and test procedures shall be witnessed and approved by the Architect.

D. After completion and approval of testing, submit "Test Certificates of Approval" for Drain piping systems stating that all test results are satisfactory. Certificates of approval must be signed by Contractor.

3.05 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 22 10 00

SECTION 22 10 01 - PLUMBING SPECIALTIES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Extent of Plumbing Specialties Work required by this section is indicated on Drawings and by requirements of this section.

B. Types of Plumbing Specialties specified in this section include the following:
   1. Roof drains.
   2. Floor drains.
   3. Cleanouts.

1.02 REFERENCES

A. ANSI/ASSE 1015 - Backflow Preventers, Double Check Principle.

B. ANSI/ASSE 1011 - Hose Connection Vacuum Breakers.

C. ANSI/ASSE 1013 - Backflow Preventers, Reduced Pressure Principle.

D. ANSI/ASSE 1019 - Wall Hydrants, Frost Proof Automatic Draining Anti-Backflow Types.

E. ANSI A112.21.1 - Floor Drains and Area Drains.

F. ANSI A112.21.2 - Roof Drains.

G. ANSI A112.26.1 - Water Hammer Arresters.

H. PDI WH-201 Water Hammer Arresters.

I. NFPA 54 - National Fuel Gas Code, latest edition.

1.03 QUALITY ASSURANCE

A. Conformance with applicable state and local codes and ordinances.

B. Manufacturer: For each product specified, provide components by same manufacturer throughout.

C. Plumbing Certification: Persons performing plumbing work shall have a current State Plumbing License.

1.04 REGULATORY REQUIREMENTS

A. Conform to applicable City codes and ordinances and NFPA 54.

1.05 SUBMITTALS

A. Submit product data in accordance with Division 01 and Section 23 00 10.

B. Include component sizes, rough-in requirements, service sizes, and finishes.

PART 2 - PRODUCTS

2.01 ROOF DRAINS

A. Roof Drain: ANSI A112.21.2; cast iron body with sump, bottom outlet, removable galvanized or cast iron dome strainer, adjustable level, membrane flange and clamp with integral gravel stop, with adjustable under deck clamp, drain receiver, and extension collar.
   1. Acceptable Manufacturers and Models:
      a. Josam — Series 21000
      b. Tyler/Wade — Series W-3010
      c. Smith — Series 1015
      d. Zurn — Series Z-113

B. Overflow Roof Drain: ANSI A112.21.2; cast iron body with sump, bottom outlet, removable galvanized or cast iron dome strainer, adjustable level, secured plastic internal water guard for 2 in. above inlet of adjacent roof drain (or as required by local code), membrane flange and clamp with integral gravel stop, adjustable under deck clamp, drain receiver, and extension collar.

1. Acceptable Manufacturers and Models:

a.	Josam	Series 26000
b.	Smith	Series 1074
c.	Tyler/Wade	Series W-3000-SD

C. Downspout Nozzle (DSN): Bronze, wall flange and threaded inlet.

1. Acceptable Manufacturers and Models:

a.	Josam	Series 25010
b.	Smith	Series 1770
c.	Tyler/Wade	Series W-3940
d.	Zurn	Series Z-199

2.02 FLOOR DRAINS

A. Floor drain: ANSI A112.21.1; cast iron body, double drainage flange, weep holes, bottom outlet, vandal proof secured 6 in. dia. nickel bronze adjustable flat strainer, and non-puncturing flashing collar.

1. Acceptable Manufacturers and Models:

a.	Josam	Series 30000-6A
b.	Smith	Series 2010-A
c.	Tyler/Wade	Series W-1100
d.	Zurn	Series Z-415

2.03 CLEANOUTS

A. Clean out: Cast iron body, adjustable type, inside caulk connection, standard round nickel bronze top, threaded bronze plug.

1. Acceptable Manufacturers and Models:

a.	Josam	Series 56000-X-22-15
b.	Smith	Series 4028C-U
c.	Tyler/Wade	Series W-6000-IC-5
d.	Zurn	Series ZN-1400IC-BP-VP

B. Clean out: Cast iron clean out tee type with countersunk tapered threaded bronze plug. Provide "T" handle wrench.

1. Acceptable Manufacturers and Models:

a.	Josam	Series 58910
b.	Smith	Series 4512S
c.	Zurn	Series Z-1445-BP

PART 3 - EXECUTION

3.01 PREPARATION

A. Coordinate cutting of roof construction to receive drains to required invert elevations.

3.02 INSTALLATION AND APPLICATION

A. Install specialties in accordance with manufacturer's instructions to permit intended performance.

B. Extend cleanouts to finished floor or wall surface. Lubricate threaded clean out plugs with mixture of graphite and linseed oil. Ensure clearance at clean out for rodding of drainage system.

C. Encase yard cleanouts in concrete flush with grade when not located in concrete, pavement, sidewalk, etc.

D. Trap all drains connected to the sanitary sewer.

E. Install floor and area drains with top depressed 1/2 in. below finished floor elevation.

F. Inlet of overflow drain shall be 2 in. above inlet of adjacent roof drain (or as required by local code).

G. In addition to cleanouts, as shown on the Drawings, Contractor shall provide any additional cleanouts required by local codes and ordinances at no additional cost to the Owner.

H. Outlet of plumbing vents and flues shall be located a minimum of 10 ft. 0 in. from fresh air intakes. Provide offset as required.

I. Relief valve discharge drain from reduced pressure backflow preventers shall be piped full outlet size down to nearest floor drain. Drain line shall terminate above floor drain with air gap.

J. Pipe Flashing:
   1. Open-end dry vent pipes passing through roof waterproofing membrane shall be installed through a 4-pound lead flashing or a 16-ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 8 in. from the pipe and shall be set over the roof membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe and turn down into the pipe to form a waterproof joint. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed with tightly pack fiberglass wool insulation.
   2. Closed end pipes passing through roof waterproofing membrane shall be installed through a cast iron sleeve with caulking recess, anchor lugs, flashing-clamp device, pressure ring with brass bolts and deck clamping assembly. Flashing shield shall be fitted into the sleeve-clamping device.

K. Install trap primers on all floor drains unless specifically not required by local codes.

L. All trap primers shall be concealed, within cabinets, walls and/or chases as approved by the Architect. Install access doors at each valve location.

M. Install line size wye-pattern strainer upstream of backflow preventer. Strainer shall be lead free for all potable water systems.

3.03 TESTING

END OF SECTION 22 10 01

SECTION 22 11 19 - PIPING SPECIALTIES

PART 1 - GENERAL

1.01 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. Mechanical Penetration Seals.
   3. Penetration Seals.

C. Piping specialties furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division 22 sections.

1.02 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".

1.03 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

2.01 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.

2.02 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 ring.

C. Pipe Escutcheons for Dry Areas: Provide sheet steel escutcheons, solid ring.

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.

2.03 PENETRATION SEALS

A. 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.

2.04 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

3.01 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. 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.

C. 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.

D. 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.

E. Penetration Seals:
   1. 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.

END OF SECTION 22 11 19

SECTION 23 00 10 - BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.01 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".

1.02 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.

1.03 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.

1.04 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.

1.05 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
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. International Code Council (ICC) 2015:
   1. IMC 2015 International Mechanical Code
   2. IECC 2015 International Energy Conservation Code
   3. IPC 2015 Internation Plumbing Code

E. American Society of Mechanical Engineers (ASME): Boiler and Pressure Vessel Codes.

F. Air Conditioning and Refrigeration Institute Standards (ARI): All standards related to refrigeration and air conditioning equipment and piping furnished under these Specifications.

G. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) 1985: All applicable manuals and standards.

H. Air Moving and Conditioning Association (AMCA): All applicable manuals and standards.

I. American Society of Testing and Material (ASTM): All applicable manuals and standards.

J. American Water Works Association (AWWA): All applicable manuals and standards.

K. National Electrical Manufacturer's Association (NEMA): All applicable manuals and standards.

L. City Fire Department as applicable to construction of this site.

M. City and State Building Codes.

N. State of (Texas) Occupational Safety Act: Applicable safety standards.

O. Occupational Safety and Health Act (OSHA).

P. State of (Texas) Energy Conservation Construction Code.

Q. All work shall be in accordance with all regulations and requirements of the State of Texas Architectural Barriers Act (TAS).

R. Refer to Specifications sections hereinafter bound for additional codes and standards.

S. 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.

T. All equipment provided and all installation methods shall meet all applicable requirements of the International Energy Conservation Code.

U. 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.

1.06 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.

1.07 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.

1.08 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.

1.09 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.

1.10 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 and Owner.

1.11 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.

1.12 OPERATING AND MAINTENANCE INSTRUCTIONS

A. The Contractor shall prepare, one hard copy and one electronic copy of 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.

1.13 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, and shall include Contractor response within 24 hours of initial notification by Owner.

C. Certain items for equipment shall have additional or extended warranties when so specified.

1.14 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.

1.15 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.

1.16 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.

1.17 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.

1.18 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. Sleeves shall be installed prior to duct/pipe installation.

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. Insulation will be installed prior to installation pipe/duct through sleeves.
   2. Sleeves installed before pipe/duct.

1.19 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. Refer to Architectural Specification Division 08 for requirements.

C. 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.

1.20 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.

1.21 MECHANICAL SUBMITTALS

A. Refer to the Conditions of the Contract (General and Supplementary) and Division 01 Section: "SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES" for submittal definitions, requirements, and procedures.

B. Submittal of Shop Drawings, product data, and samples will be accepted only when submitted by The Contractor. Data submitted from Subcontractors and material suppliers directly to the Architect will not be processed.

C. Submit Shop Drawings, product data, and samples on items indicated in the individual sections.

D. Shop Drawings and submittal 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.

1.22 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Refer to the Instructions to Bidders and the Division 01 Section "PRODUCTS AND SUBSTITUTION" 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 Owner'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
Owner's Familiarity with the Product	

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.

F. The Owner shall make the final decision on any substitution.

1.23 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.

1.24 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.

1.25 CLEANING

A. Refer to the Division 01 Section: "CLOSEOUT PROCEDURES" for general requirements for final cleaning.

B. Refer to Division 23 Section: "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 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.

1.26 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 -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

Motor efficiency certification shall be included with Product Submittal Data in accordance with Division 01 of these specifications.

3. 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.

4. 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

2.01 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 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.

2.02 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.

2.03 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.

2.04 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. Electrical bus duct
6. Supply ductwork
7. Return ductwork
8. Exhaust ductwork
9. Chilled water and heating water piping

10. Automatic Fire Protection Sprinkler Piping
11. Domestic hot and cold water piping
12. Electrical conduit

2.05 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 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.

2.06 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.

PART 3 - INSTALLATION

3.01 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.

3.02 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.

3.03 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.

3.04 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. Air Handling Units
2. Air conditioning control panels and switches
3. Motor controllers
4. 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.

3.05 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. **The Contractor shall coordinate with the Owner-provided Test and Balance Contractor as required, and shall make any necessary adjustments required to ensure a fully functional system to the satisfaction of the Owner.**

F. 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.

3.06 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.

3.07 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.

3.08 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".

3.09 TEMPORARY FACILITIES

A. Unless noted otherwise in the Supplementary General Conditions; provide temporary facilities.

3.10 EQUIPMENT INSTALLATION REQUIREMENTS

A. All mechanical 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 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.

3.11 EXCAVATION, BACKFILLING AND COMPACTION

A. Provide excavation, backfilling and compaction in accordance with requirements of Division 31.

3.12 OWNER FURNISHED EQUIPMENT

A. The Contractor’s responsibility shall include receiving and installing all Owner-furnished equipment.

END OF SECTION 23 00 10

SECTION 23 05 06 - MECHANICAL DEMOLITION

PART 1 - GENERAL

1.01 SUMMARY

A. Demolition of:
   1. HVAC air handling units and related ductwork.
   2. Grilles, registers, diffusers, variable air volume boxes.
   3. Chillers, pumps 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.

1.02 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.

1.03 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. Submittal of a bid will be evidence that such an examination has been made and the various details noted.

D. 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.

E. Execute demolition work in a manner to protect adjacent equipment and other existing items against damage.

F. Provide and erect lights, barricades, warning signs, and other items as required for protection of the Owner's employees, building occupants, and the public.

G. Maintain barricades in good condition throughout the project to substantial completion.

H. 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

3.01 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.

B. Division 02.

3.02 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.

B. Division 02.

3.03 DEMOLITION

A. Perform demolition in accordance with all requirements of the Owner.

B. Division 02.

3.04 DISPOSITION OF MATERIALS

A. Dispose of all demolition items and materials in a legal off-site location.

B. Division 02.

3.05 RELOCATION AND REUSE OF MECHANICAL ITEMS

A. Relocate items indicated on the Contract Drawings as required to accommodate the new construction. Remove, relocate, clean, 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.

3.06 CLEANING

A. Section 23 00 10 - Basic Mechanical Requirements.

3.07 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.

3.08 SCHEDULING

A. Schedule demolition in strict compliance with the Owner's instructions.

3.09 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 23 05 06

SECTION 23 05 12 - MECHANICAL AND ELECTRICAL COORDINATION

PART 1 - GENERAL

1.01 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.

1.02 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.

1.03 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
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

	ITEM	FURNISHED UNDER DIVISION	INSTALLED UNDER DIVISION	WIRED AND CONNECTED UNDER DIVISION
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
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

	ITEM	FURNISHED UNDER DIVISION	INSTALLED UNDER DIVISION	WIRED AND CONNECTED UNDER DIVISION
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

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. Refrigerant piping
      f. Electrical bus duct
      g. Supply ductwork
      h. Return ductwork
      i. Exhaust ductwork
      j. Chilled water and heating water piping
      k. Automatic Fire Protection Sprinkler Piping
      l. Domestic hot and cold water piping
      m. 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 23 05 12

SECTION 23 05 19 - MECHANICAL METERS AND GAUGES

PART 1 - GENERAL

1.01 SUMMARY

A. Extent of meters and gauges required by this section is indicated on Drawings and/or specified in other Division 23 sections.

B. Types of meters and gauges specified in this section include the following:.
   1. Temperature Gauges and Fittings.
      a. Solar-Powered Digital Thermometers.
      b. Thermometer Wells.
      c. Temperature Gauge Connector Plugs.
   2. Pressure Gauges and Fittings.
      a. Pressure Gauges.
      b. Pressure Gauge Cocks.
      c. Pressure Gauge Connector Plugs.
   3. Flow Measuring Meters.
      a. Calibrated Balance Valves.

C. Meters and gauges furnished as part of factory-fabricated equipment are specified as part of equipment assembly in other Division 23 sections.

1.02 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of meters and gauges, 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. UL Compliance: Comply with applicable UL standards pertaining to meters and gauges.
   2. ANSI and ISA Compliance: Comply with applicable portions of ANSI and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gauges.

C. Certification: Provide meters and gauges whose accuracies, under specified operating conditions, are certified by manufacturer.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of meter and gauge. Include scale range, ratings, and calibrated performance curves, certified where indicated. Submit meter and gauge schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gauge.

B. Maintenance Data: Submit maintenance data and spare parts lists for each type of meter and gauge. Include this data and product data in Maintenance Manual; in accordance with requirements of Division 01.

PART 2 - PRODUCTS

2.01 SOLAR-POWERED DIGITAL THERMOMETERS

A. General: Provide solar-powered digital thermometers of materials, capacities, and ranges indicated, designed and constructed for use in service indicated.

B. Adjustable Joint: Die cast aluminum, finished to match case, 180° adjustment in vertical plane, 360° adjustment in horizontal plane, with locking device.

C. Scale: Digital display

D. Stem: Stainless steel, or brass, for separable socket, length to suit installation.

E. Range: Conform to the following:
   1. Hot Water: 30° - 240°F (+/- Measurement Accuracy).
   2. Chilled Water: 30° - 180°F (+/- Measurement Accuracy).

F. Manufacturer: Subject to compliance with requirements, provide glass thermometers of one of the following, or approved equal.
   1. Trerice (H.O.) Co. (Similar to Model Sx9140305)
   2. Weiss Instruments, Inc.
   3. Weksler

2.02 THERMOMETER WELLS

A. General: Provide thermometer wells constructed of brass or stainless steel, pressure rated to match piping system design pressure. Provide 2 in. extension for insulated piping. Provide cap nut with chain fastened permanently to thermometer well.

B. Manufacturer: Same as thermometers.

2.03 TEMPERATURE GAUGE CONNECTOR PLUGS

A. General: Provide temperature gauge connector plugs pressure rated for 500 psi and 200°F (93°C). Construct of brass and finish in nickel-plate, equip with 1/4 in. NPS fitting, with self-sealing valve core type neoprene gasketed orifice suitable for inserting 1/8 in. O.D. probe assembly from dial type insertion thermometer. Equip orifice with gasketed screw cap and chain. Provide extension, length equal to insulation thickness, for insulated piping.

B. Manufacturer: Subject to compliance with requirements, provide temperature gauge connector plugs of one of the following, or approved equal:
   1. Peterson Equipment Co.
   2. Watts Regulator Co.

2.04 PRESSURE GAUGES

A. General: Provide pressure gauges of materials, capacities, and ranges indicated, designed and constructed for use in service indicated.

B. Type: General use, 1% accuracy, ANSI B40.1 grade A, phosphor bronze bourdon type, bottom connection.

C. Case: Drawn steel or brass, glass lens, 4+ in. diameter.

D. Connector: Brass with 1/4 in. male NPT. Provide protective siphon when used for steam service.

E. Scale: White coated aluminum, with permanently etched markings.

F. Range: Conform to the following:
   1. Vacuum: 30 in. Hg - 15 psi.
   2. Water: 0 - 100 psi.
   3. Steam: 0 - 200 psi.

G. Manufacturer: Subject to compliance with requirements, provide pressure gauges of one of the following, or approved equal:
   1. Ametek/U.S. Gauge.
   2. Marsh Instrument Co.; Unit of General Signal.

3. Marshalltown Instruments, Inc.
4. Trerice (H.O.) Co.
5. Weiss Instruments, Inc.

2.05 PRESSURE GAUGE COCKS

A. General: Provide pressure gauge cocks between pressure gauges and gauge tees on piping systems. Construct gauge cock of brass with 1/4 in. female NPT on each end, and "T" handle brass plug.

B. Siphon: 1/4 in. straight coil constructed of brass tubing with 1/4 in. male NPT on each end.

C. Snubber: 1/4 in. brass bushing with corrosion resistant porous metal disc, through which pressure fluid is filtered. Select disc material for fluid served and pressure rating.

D. Manufacturer: Same as for pressure gauges.

2.06 PRESSURE GAUGE CONNECTOR PLUGS

A. General: Provide pressure gauge connector plugs pressure rated for 500 psi and 200°F (93°C). Construct of brass and finish in nickel-plate equip with 1/2 in. NPS fitting, with self-sealing valve core type neoprene gasketed orifice suitable for inserting 1/8 in. O.D. probe assembly from dial type insertion pressure gauge. Equip orifice with gasketed screw cap and chain. Provide extension, length equal to insulation thickness, for insulated piping.

B. Manufacturer: Subject to compliance with requirements, provide pressure gauge connector plugs of one of the following, or approved equal:
1. Peterson Equipment Co.
2. Watts Regulator Co.

2.07 CALIBRATED BALANCE VALVES

A. General: Provide as indicated, calibrated balance valves equipped with readout valves to facilitate connecting of differential pressure meter to balance valves. Equip each readout valve with integral EPT check valve designed to minimize system fluid loss during monitoring process. Provide calibrated nameplate to indicate degree of closure of precision-machined orifice. Construct balancing valve with internal EPT O-ring seals to prevent leakage around rotating element. Provide balance valves with preformed polyurethane insulation suitable for use on heating and cooling systems, and to protect balance valves during shipment.

B. Manufacturer: Subject to compliance with requirements, provide calibrated balance valves of one of the following, or approved equal:
1. Bell & Gossett ITT; Fluid Handling Div.
2. Taco, Inc.
3. Thrush Products, Inc.
4. Griswold.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which meters and gauges are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF TEMPERATURE GAUGES

A. General: Install temperature gauges in vertical upright position, and tilted so as to be easily read by observer standing on floor.

B. Locations: Install in the following locations, and elsewhere as indicated:
   1. At inlet and outlet of each hydronic zone.
   2. At inlet and outlet of each hydronic boiler, chiller and cooling tower.
   3. At inlet and outlet of each hydronic coil in air handling units, and built-up central systems.
   4. At inlet and outlet of each hydronic heat exchanger.
   5. At inlet and outlet of each hydronic heat recovery unit.
   6. At inlet and outlet of each thermal storage tank.
   7. At outlet of each hot water circulation pump.

C. Remote Reading Dial Thermometers: Install on control panels as indicated. Run tubing between panel and thermometer bulb, adequately supported to prevent kinks. Select tubing length so as to not require coiling of tubing.

D. Thermometer Wells: Install in piping tee where indicated, in vertical upright position. Fill well with oil or graphite, secure cap.

E. Temperature Gauge Connector Plugs: Install in piping tee where indicated, located on pipe at most readable position. Secure cap.

3.03 INSTALLATION OF PRESSURE GAUGES

A. General: Install pressure gauges in piping tee with pressure gauge cock, located on pipe at most readable position.

B. Locations: Install in the following locations, and elsewhere as indicated:
   1. At suction and discharge of each pump.
   2. At discharge of each pressure reducing valve.
   3. At water service inlet.
   4. At inlet and outlet of water-cooled condensers and refrigerant-cooled chillers.

C. Pressure Gauge Cocks: Install in piping tee with snubber. Install siphon for steam pressure gauges.

D. Pressure Gauge Connector Plugs: Install in piping tee where indicated, located on pipe at most readable position. Secure cap.

3.04 INSTALLATION OF FLOW MEASURING METERS

A. General: Install flow measuring meters on piping systems located in accessible locations at most readable position.

B. Locations: Install in the following locations, and elsewhere as indicated.
   1. At inlet of each hydronic coil in built-up central systems.

C. Calibrated Balance Valves: Install on piping with readout valves in vertical upright position. Maintain minimum length of straight unrestricted piping equivalent to 3 pipe diameters upstream of valve.

3.05 ADJUSTING AND CLEANING

A. Adjusting: Adjust faces of meters and gauges to proper angle for best visibility.

B. Cleaning: Clean windows of meters and gauges and factory-finished surfaces. Replace cracked or broken windows, repair any scratched or marred surfaces with manufacturer's touch-up paint.

END OF SECTION 23 05 19

SECTION 23 05 29 - MECHANICAL SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.01 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.

1.02 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. 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

1.03 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

2.01 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. Adjustable Swivel Pipe Rings: MSS Type 6.

H. Single Pipe Rolls: MSS Type 41.

2.02 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.

2.03 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.

2.04 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.

2.05 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

2.06 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.

2.07 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.

2.08 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.

2.09 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
6 in.	No. 3 bars	18 in. on center each way (3 in. from top of pad

2.10 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

3.01 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.

3.02 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 Architect for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

3.03 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.

3.04 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. Threaded rods will be one continuous piece.

D. Support fire-water piping independently of other piping.

E. Prevent electrolysis in support of copper tubing by use of hangers and supports that are copper plated, or by other recognized industry methods.

F. 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.

G. 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.

H. 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.

3.05 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.

3.06 CONCRETE HOUSEKEEPING BASES

A. Concrete housekeeping bases will be provided as work of Division 03. Furnish to Contractor, scaled layouts of all required bases, with dimensions of bases, and location to column centerlines. Furnish templates, anchor bolts, and accessories, necessary for base construction.

B. 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.

3.07 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.

3.08 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 23 05 29

SECTION 23 05 48 - MECHANICAL VIBRATION CONTROL

PART 1 - GENERAL

1.01 SUMMARY

A. Extent of vibration control work required by this section is indicated on Drawings and schedules, and/or specified in other Division 23 sections.

B. Types of vibration control products specified in this section include the following:
   1. Vibration Isolation Springs
   2. Isolation Hangers
   3. Flexible Pipe Connectors

C. Vibration control products furnished as integral part of factory-fabricated equipment are specified as part of equipment assembly in other Division 23 sections.

D. Refer to other Division 23 sections for equipment foundations, hangers, sealants, gaskets, and other work related to vibration control work.

E. Refer to other Division 23 sections for requirements of electrical connections to equipment isolated on vibration control products.

F. Refer to other Division 23 sections for requirements of duct connections to air handling equipment isolated on vibration control products.

1.02 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of vibration control products, of type, size, and capacity required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Except as otherwise indicated, obtain vibration control products from single manufacturer.

C. Engage manufacturer to provide technical supervision of installation of vibration control products.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of vibration control product. Submit schedule showing size, type, deflection, and location for each product furnished.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weights, required clearances, and method of assembly of components. Details bases, and show location of equipment anchoring points, coordinated with equipment manufacturer's shop drawings.

C. Maintenance Data: Submit maintenance data for each type of vibration control product. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 01.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Submit to compliance with requirements; provide vibration control products of one of the following:
   1. Amber/Booth Co.
   2. Consolidated Kinetics, Inc.
   3. Korfund Dynamics Corp.
   4. Mason Industries, Inc.

5. Peabody Noise Control, Inc.
6. Vibration Eliminator Co., Inc.
7. Vibration Mountings and Controls, Inc.

2.02 VIBRATION CONTROL MATERIALS AND SUPPORT UNITS:

A. Vibration Isolation Springs: Wound-steel compression springs, of high-strength spring alloy steel; with spring diameter not less than 0.8 of compressed height of spring at rated loads. Provide minimum additional travel to solid, equal to 50% of rated deflection. Provide spring wire with elastic limit stress exceeding at solid deflection.

B. Isolation Hangers:
   1. Hanger units formed with brackets and including manufacturer's standard compression isolators of type indicated. Design brackets for 3 times rated loading of units. Fabricate units to accept misalignment of 30° off center in any direction before contracting hanger box, and for use with either rod or strap type members, and including acoustical washers to prevent metal-to-metal contacts.
   2. Provide hangers, precompressed to rate load to limit deflection during installation. Design so hanger may be released after full load is applied.

C. Flexible Pipe Connectors:
   1. For non-ferrous piping, provide bronze hose covered with bronze wire braid with copper tube ends or bronze flanged ends, braze-welded to hose.
   2. For ferrous piping, provide stainless steel hose covered with stainless steel wire braid with NPT steel nipples or 150 psi ANSI flanges, welded to hose.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which vibration control units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 PERFORMANCE OF ISOLATORS

A. General: Comply with minimum static deflectors recommended by ASHRAE, for selection and application of vibration isolation materials and units as indicated.

B. Manufacturer's Recommendations: Except as otherwise indicated, comply with manufacturer's recommendation for selection and application of vibration materials and units.

3.03 APPLICATIONS

A. General: Except as otherwise indicated, select vibration control products in accordance with ASHRAE Handbook, 2015 Applications Volume, Chapter 48 "Noise and Vibration Control," Table 47. Where more than one type of product is offered, selection is Installer's option.

B. Piping:
   1. For piping connected to equipment mounted on vibration control products, install isolation hangers as indicated, and for first 3 points of support for pipe sizes 4 in. and less, for first 4 points of support for pipe sizes 5 in. through 8 in., and for first 6 points of support for pipe sizes 10 in. and over.

3.04 INSTALLATION

A. General: Except as otherwise indicated, comply with manufacturer's instructions for installation and load application to vibration control materials and units. Adjust to ensure that units have equal deflection, do not bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices intended for temporary support during installation.

B. Install units between substrate and equipment as required for secure operation and to prevent displacement by normal forces, and as indicated.

C. Adjust leveling devices as required to distribute loading uniformly onto isolators. Shim units as required where substrate is not level.

D. For air handling equipment, install thrust restraints as indicated, and also wherever thrust exceeds 10% of equipment weight.

E. Locate isolation hangers as near overhead support structure as possible.

F. Weld riser isolator units in place as required to prevent displacement from loading and operations.

G. Flexible Pipe Connectors: Install on equipment side of shutoff valves, horizontally and parallel to equipment shafts wherever possible.

3.05 ADJUSTING AND CLEANING

A. Upon completion of vibration control work, prepare report showing measured equipment deflections for each major item of equipment as indicated.

B. Clean each vibration control unit, and verify that each is working freely, and that there is no dirt or debris in immediate vicinity of unit that could possibly short-circuit isolation.

END OF SECTION 23 05 48

SECTION 23 05 53 - MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.01 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 Duct Markers.
   3. Valve Tags.
   4. Valve Schedule Frames.
   5. Engraved Plastic-Laminate Signs.

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.

1.02 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.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.

B. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.

C. 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.

D. Maintenance Data: Include product data and schedules in maintenance manuals; in accordance with requirements of Division 01.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide mechanical identification materials of one of the following:
   1. Allen Systems, Inc.
   2. MSI (Marking Services Inc.)

3. Brady (WHO) Co.; Signmark Div.
4. Industrial Safety Supply Co., Inc.
5. Seton Name Plate Corp.

2.02 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.

2.03 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. Insulation: Furnish 1 inch thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on un-insulated pipes subjected to fluid temperatures of 125°F (52°C) or greater. Cut length to extend 2 in. beyond each end of plastic pipe marker.

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.

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. Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.

E. Lettering: As shown on Drawing for each piping system in each instance, or as selected by Architect in cases of variance with Manufacturer's standard pre-printed nomenclature.

F. Lettering: Comply with piping system nomenclature as specified, scheduled or shown, and abbreviate only as necessary for each application length. Pipe markers shall have same abbreviation as on drawings.
   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.

2.04 PLASTIC DUCT MARKERS

A. Coordinate system colors with Owner before installation.

B. 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.

C. 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.

2.05 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.

2.06 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.

2.07 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.

2.08 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

3.01 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.

3.02 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 50' 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.

3.03 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 25 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
Heating Water Supply	Green	White
Heating Water Return	Green	White

CONTRACTOR SHALL IDENTIFY SPECIFIC PRESSURE FOR EACH STEAM SYSTEM

3.04 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.

1. Where more than one major machine room is shown for project, install mounted valve schedule in each major machine room, and repeat only main valves which are to be operated in conjunction with operations of more than single machine room.

3.05 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. Heat exchanger, coils, evaporators, cooling towers, heat recovery units and similar equipment.
4. Fans, blowers, primary balancing dampers and mixing boxes.
5. Packaged HVAC central-station and zone-type units.
6. Strainers, filters, humidifiers, water treatment systems and similar equipment.

B. Optional Sign Types: Where lettering larger than 1 in. height is needed for proper identification, because of distance from normal location of required identification, stenciled signs may be provided in lieu of engraved plastic, at Installer's option.

C. 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.

D. 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.

3.06 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.

3.07 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 23 05 53

SECTION 23 05 93 - MECHANICAL TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.01 SUMMARY

A. Testing and balancing shall be provided by Owner. The Contractor shall coordinate with the Test and Balance Contractor as a part of this contract, in accordance with Specification Section 22 00 10 - 3.05.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.01 INSPECTION

A. Inspect preceding work in accordance with Section 23 00 10 BASIC MECHANICAL REQUIREMENTS.

3.02 COMPLETION SERVICES

A. Final Check: Make final checks and do any rebalancing as directed.

B. 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 23 05 93

SECTION 23 07 13 - HVAC DUCT INSULATION

PART 1 - GENERAL

1.01 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.

E. Refer to Section 23 05 53 - MECHANICAL IDENTIFICATION for installation of identification devices for piping, ductwork, and equipment; not work of this section.

1.02 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 (NFPA 255) method.

1.03 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.

B. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in maintenance manual.

C. Samples: Submit manufacturer’s sample of each piping insulation type required, and of each duct and equipment insulation type required. Affix label to sample completely describing product.

1.04 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

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
   1. Manson.

2. Knauf Fiber Glass.
3. Johns Manville Products Corp.
4. Owens-Corning Fiberglass Corp.
5. 3M

2.02 DUCTWORK INSULATION MATERIALS

A. Rigid Fiberglass Ductwork Insulation: ASTM C 612, Class 1.

B. Flexible Fiberglass Ductwork Insulation: ASTM C 553, Type I, Class B-4.

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.
   1. Encase exterior ductwork insulation with aluminum jacket with weatherproof construction, as specified.

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.

2.03 METAL PROTECTIVE JACKET

A. Sheet aluminum: ASTM B209, 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. A two-inch overlap is required at longitudinal and circumferential joints.

PART 3 - EXECUTION

3.01 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, in accordance with standards of T.I.M.A, but in no cases less than as specified herein.

3.02 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 in. thick, application limited to concealed locations. Flexible insulation will not be used in machine, fan and equipment rooms.
c. No fiberglass duct liner.

3.03 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. 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.

3.04 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 screws, rivets, or 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.

3.05 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.

3.06 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 23 07 13

SECTION 23 07 19 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.01 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. Calcium Silicate.
      c. Flexible Unicellular.

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.

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.

1.02 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 (NFPA 255) method.

1.03 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.

B. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in maintenance manual.

C. Samples: Submit manufacturer’s sample of each piping insulation type required, and of each duct and equipment insulation type required. Affix label to sample completely describing product.

1.04 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

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
   1. Armstrong World Industries, Inc.
   2. Babcock & Wilcox; Insulating Products Div.
   3. CertainTeed Corp.
   4. Knauf Fiber Glass.
   5. Johns Manville Products Corp.
   6. Owens-Corning Fiberglass Corp.
   7. Thermacor Process, Inc. (CT1 9501)

2.02 PIPING INSULATION MATERIALS

A. Fiberglass Piping Insulation: ASTM C 547, Class 1 unless otherwise indicated.

B. Flexible Unicellular Piping Insulation: ASTM C 534, Type I.

C. Jackets for Piping Insulation: ASTM C 921, 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.
   2. Encase exterior piping insulation with aluminum jacket with weather-proof construction.

D. Staples, Bands, Wires and Cement: As recommended by insulation manufacturer for applications indicated.

E. Adhesives, Sealers and Protective Finishes: As recommended by insulation manufacturer for applications indicated.

2.03 METAL PROTECTIVE JACKET

A. Sheet aluminum: ASTM B209, 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. A two-inch overlap is required at longitudinal and circumferential joints.

PART 3 - EXECUTION

3.01 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, in accordance with standards of T.I.M.A, but in no cases less than as specified herein.

3.02 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. 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. Flexible Unicellular: 1 in. thick.

C. Hot Low Pressure Piping (to 248°F (120°C)):
   1. Application Requirements: Insulate the following hot low-pressure HVAC piping systems (steam piping up to 14 psi water piping up to 248°F (120°C)).
      a. HVAC hot water supply and return piping.
   2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:
      a. Fiberglass: 2 in. thick.

D. Insulation of Piping Exposed to Weather: Protect outdoor insulation from weather by installing outdoor protective finish or jacketing as recommended by the manufacturer.

3.03 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-barrier 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. Self-sealing lap and butt joints will not be acceptable as the only seal on pipe insulation. May be used if additionally sealed with mastic.

J. Mastic will be applied using manufacturer's instructions for thickness and number of applications.

K. 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.

3.04 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 screws, rivets, or 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.

3.05 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.

3.06 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 23 07 19

SECTION 23 09 23 - BUILDING CONTROL SYSTEM (BCS)

PART 1 - GENERAL

1.01 GENERAL

A. All work shall be in accordance with Division 01 and Section 23 00 10 "BASIC MECHANICAL REQUIREMENTS".

1.02 SCOPE OF WORK

A. Furnish all labor, materials, tools, equipment, and services to extend a fully integrated Building Control System (BCS) as indicated, in accordance with the Contract Documents, into the renovated project areas.

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 Application Specific Controller (ASC) for each air-handling unit, packaged rooftop unit, make-up air unit, fan coil unit, etc.
   2. Integration to third-party manufacturers' microprocessor controllers, as specified herein.
   3. Furnish and install all sensors, transducers, and controlled devices per this specification.
   4. Furnish all automatic control valves and control dampers for installation by the Mechanical Installer. Furnish and install all control damper and control valve actuators.
   5. All monitoring, controlling, optimizing, interfacing, reporting, archiving, operator interface and information formulation and other special packages as required by the Contract Documents shall be fully integrated into the existing building control system, 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.

1.03 CONTRACTOR QUALIFICATIONS

A. An extension of the integrated BCS will only be considered for acceptance from the following companies:
   1. Siemens Building Technologies

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.

1.04 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.

1.05 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

2.01 GENERAL DESCRIPTION

A. The BCS shall be capable of integrating multiple building functions including equipment supervision and control, alarm management, energy management, lighting control, information management, and historical data collection and archiving as well as trending.

B. The BCS shall consist of the following:
   1. Network Control Panels (NCPs)
   2. Application Specific Controllers (HVAC, TUC, etc.)

3. Portable Operator Terminals
4. PC-Based Operator Workstations

C. System shall be modular in nature and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, Network Control Panels, and operator devices.

D. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution. Each NCP and ASC shall operate independently by performing its own specified control, alarm management, operator I/O, and historical data collection as well as trending. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

E. Network Control Panels shall be able to access any data from, or send control commands and alarm reports directly to, any other controller on the network without dependence upon a central processing device, such as a central file server. Network Control Panels shall also be able to send alarm reports to multiple operator workstations, terminals, and printers without dependence upon a central processing device or file server.

2.02 NETWORKING/COMMUNICATIONS

A. The design of the BCS shall network Operator workstations (fixed and portable) and Network Control Panels. Inherent in the system's design shall be the ability to expand or modify the network.

B. Local Area Network
1. Workstation/Network Control Panel Support. Operator workstations and NCPs shall directly reside on a single shared high-speed local area network such that communications may be executed directly between controllers, directly between workstations, and between controllers and workstations on a peer-to-peer basis.
2. Dynamic Data Access. All operator devices, either network resident or connected via the internet, shall have the ability to access all point status and application report data or execute control functions for any and all other devices via the local area network. Access to data shall be based upon logical identification of building equipment.
3. General Network Design. Network design shall include the following provisions:
   a. High-speed data transfer rates for alarm reporting, quick report generation from multiple controllers, and upload/download efficiency between network devices.
   b. Support of any combination of controllers and Operator workstations directly connected to the local area network.
   c. Detection and accommodation of single or multiple failures of workstations, NCP, or the network media. The network shall include provisions for automatically reconfigure itself to allow all operational equipment to perform their designated functions as effectively as possible in the event of single or multiple failures.
   d. Message and alarm buffering to prevent information from being lost.
   e. Error detection, correction, and re-transmission to guarantee data integrity.
   f. Default device definition to prevent loss of alarms or data and to ensure alarms are reported as quickly as possible in the event an operator device does not respond.
   g. Automatic synchronization for the real-time clocks in all NCPs and ASCs shall be provided.

2.03 NETWORK CONTROL PANELS

A. Network Control Panels shall be microprocessor-based, multi-tasking, multi-user, real-time digital control processors. Each NCP shall consist of modular hardware with plug-in enclosed processors, communication, controllers, power supplies, and input/output modules.

A sufficient number of controllers shall be provided to fully meet the requirements of this specification and the attached point list. A 20% installed spare capacity of each point type (AI, AO, DI, DO) shall be provided at each NCP as part of the base bid. The BCS point capacity shall be capable of being expanded by 200% by the addition of NCPs and ASCs. The BCS shall also support an additional two workstations above those specified herein.

B. Each NCP shall have sufficient memory to support its own operating system and databases including:
   1. DDC and other control Processes
   2. Energy Management Applications
   3. Alarm Management
   4. Historical/Trend Data for all points
   5. Maintenance Support Applications
   6. Custom Processes
   7. Operator I/O
   8. Network Communications
   9. Manual Override Monitoring

C. Each NCP shall support the following types of point inputs and outputs:
   1. Digital inputs for status/alarm contacts.
   2. Digital outputs for on/off equipment control.
   3. Analog inputs for temperature, pressure, humidity, flow, and position measurements.
   4. Analog outputs for valve and damper modulation, and capacity control of primary equipment.
   5. Pulse inputs for pulsed contact monitoring.

D. The BCS shall be modular in nature and shall permit expansion through the addition of software applications, workstation hardware, field controllers, sensors, and actuators. The system architecture shall support 200% expansion capacity of all types of DDC panels and all point types included in the initial installation.

E. Network Control Panels shall provide at least two RS-232C serial data communication ports for simultaneous operation of operator I/O devices such as industry standard printers, laptop workstations, PC workstations, modems and portable operator terminals.

F. Surge and transient protection shall be provided at all network terminations, as well as all field point terminations, to suppress induced voltage transients consistent with UL 1449.

G. In the event of the loss of normal power, there shall be an orderly shutdown of all Network Control Panels to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data, and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours. Upon restoration of normal power, the NCP shall automatically resume full operation without manual intervention.

2.04 SYSTEM SOFTWARE FEATURES

A. General
   1. All necessary software to form a complete operating system as described in this specification shall be provided.
   2. The software programs specified in this section shall be provided as an integral part of the NCP or ASC and shall not be dependent upon any higher-level computer for execution.

B. Control Software Description

1. Control Algorithms. The NCP and ASC shall have the ability to perform the following control algorithms:
    a. Two-Position Control
    b. Proportional Control
    c. Proportional plus Integral Control
    d. Proportional, Integral, plus Derivative Control
    e. Adaptive Control Loop Tuning
2. Equipment Cycling Protection. Control software shall include a provision for limiting the number of times each piece of equipment may be cycled within any one-hour period. Minimum equipment cycle times shall be coordinated with the equipment manufacturer.
3. Equipment Delays. The system shall provide protection against excessive demand situations during start-up periods by automatically introducing time delays between successive start commands to electrical loads.
4. Powerfail Motor Restart. Upon the resumption of normal power, the NCP and ASC panels shall analyze the status of all controlled equipment, compare it with normal occupancy scheduling, and turn equipment on or off as necessary to resume normal operation.

C. Energy Management Applications
1. NCP and ASC panels shall have the ability to perform the following energy management routines:
    a. Scheduled stop/start
    b. Optimum start/stop.
    c. Run time totalization.
    d. Duty cycling.
    e. Power demand control.
    f. Night Setback Control.
    g. Enthalpy or Dry Bulb Economizer.
    h. Chilled Water Reset.
    i. Heating/Cooling Interlocks.
    j. Supply Air Temperature Reset.
    k. Hot Water Reset.
2. All programs shall be executed automatically without the need for operator intervention and shall be flexible to allow operator customization. Programs shall be applied to building equipment as described in the Execution portion of this specification and in the I/O point sheets.

D. Custom Process Programming Capability. NCP and ASC shall be able to execute custom, job-specific processes defined by the operator to automatically perform calculations and special control routines.
1. Process Inputs and Variables. It shall be possible to use any of the following in a custom process:
    a. Any system-measured point data or status
    b. Any calculated data
    c. Any results from other processes
    d. User-defined constants
    e. Arithmetic functions (+, -, *, /, square root, exponential, etc.)
    f. Boolean logic operators (and, or, exclusive or, etc.)
    g. On-delay/Off-delay/One-shot timers

2. Process Triggers. Custom processes may be triggered based on any combination of the following:
    a. Time interval
    b. Time of day
    c. Date
    d. Other processes
    e. Time programming
    f. Events (e.g., point alarms)

E. Alarm Management. Alarm management shall be provided to monitor, buffer, and direct alarm reports to operator devices and memory files. Each NCP and ASC shall perform distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic, and prevent alarms from being lost. At no time shall the NCP or ASC panel's ability to report alarms be affected by either operator activity at a PC workstation or local I/O device, or communications with other controllers on the network.
    1. Point Change Report Description. All alarm or point change reports shall include the point's English language description, and the time and date of occurrence.
    2. Prioritization. The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of five priority levels shall be provided.
    3. Report Routing. Alarm reports, messages, and files will be directed to a user-defined list of operator devices or PC disk files used for archiving alarm information. Alarms shall also be automatically directed to a default device in the event a primary device is found to be off-line.
    4. Alarm Messages. In addition to the point's descriptor and the time and date, the user shall be able to print, display, or store an 80-characer alarm message to more fully describe the alarm condition or direct operator response.
    5. Transaction Logging. Operator commands and system events shall be automatically logged to disk in personal computer industry standard database format. Operator commands initiated from direct-connected workstations, dial-up workstations and portable Operator workstation shall all be logged to this transaction file. This data shall be available at the Operator workstation(s).

F. Historical Data and Trend Analysis. A variety of historical data collection utilities shall be provided to automatically sample, store, and display system data in all of the following ways:
    1. Continuous Point Histories. Network Control Panels shall store point history files for all analog and digital points. Sufficient memory shall be provided within each NCP and ASC to accommodate all historical data collection described in this section.
    2. The point history routine shall continuously and automatically sample the value of all analog inputs at intervals determined by the Operator. Samples for all points shall be stored for the past 24 hours to allow the user to immediately analyze equipment performance and all problem-related events for the past day. Point history files for all points shall include a continuous record of the last ten status changes or commands for each point.
    3. Extended Sample Period Trends. Measured and calculated analog and binary data shall also be assignable to user-definable trends for the purpose of collecting operator-specified performance data over extended periods of time. Sample intervals of 1 minute to 2 hours shall be provided. Each NCP, ASC and portable Operator workstation shall have dedicated memory buffers/hard disk space for trend data.

4. Data Storage and Archiving. Trend data shall be stored at the Network Control Panels and uploaded to hard disk storage when archival is desired.

G. Runtime Totalization. Network Control Panels shall automatically accumulate and store runtime hours for binary input and output points as specified in the Execution portion of this specification.

H. Analog/Pulse Totalization. Network Control Panels shall automatically sample, calculate, and store consumption totals on a daily, weekly, or monthly basis for user-selected analog and binary pulse input-type points.

I. Event Totalization. Network Control Panels shall have the ability to count events such as the number of times a pump or fan system is cycled on and off. Event totalization shall be performed on a daily, weekly, or monthly basis.

2.05 APPLICATION SPECIFIC CONTROLLERS

A. HVAC Controllers.

1. Each Network Control Panel shall be able to extend its performance and capacity through the use of remote Application Specific Controllers (ASCs).
2. Each ASC shall operate as a standalone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall be a microprocessor-based, multi-tasking, and real-time digital control processor.
3. Each ASC shall have sufficient memory to support its own operating system and data bases including:
   a. Control Processes
   b. Energy Management Applications
4. The operator interface to any ASC point data or programs shall be through any network-resident PC workstation or portable Operator's workstation connected to any NCP in the network.
5. Powerfail Protection. All system set points, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the controller.
6. Configuration Upload and Download. The ASCs shall have the capability of receiving configuration and program loading by all of the following: 1) locally, via a direct connect portable laptop service tool, 2) over the network, from the portable laptop service tool; and 3) from the Operator Workstation(s), via the communication networks.
7. Continuous Zone Temperature Histories. Application Specific Controllers shall have the capability to automatically and continuously maintain a history of the associated zone temperature to allow users to quickly analyze space comfort and equipment performance for the past 24 hours. A minimum of two samples per hour shall be stored in the ASC or shall be uploaded to the associated NCP or Operator Workstation.

2.06 INTEGRATION WITH THIRD-PARTY MANUFACTURER CONTROLLERS

A. Interoperability With Equipment Controllers.

1. The BCS shall be capable of interoperating with multiple building systems supplied by different manufacturers. The BCS shall be able to receive, react to, and send information from/to multiple equipment controllers.
2. The system shall allow the custom generation of third-party vendor code on a local level to permit any system to be fully integrated into the BCS network.
3. Input and output points from the third-party controllers shall have real-time interoperability with BCS software features such as Control Software, Energy Management, Custom Process Programming, Alarm Management, Historical Data and

Trend Analysis, Totalization, and Dial-Up and Local Area Network Communications, as described previously in the contract documents.

B. Networking/Communications.
   1. The BCS shall support any combination of third-party controllers (if more than one third-party manufacturer is being integrated) on a single network.
   2. A minimum of 100 third-party controllers shall be supported on a single network, or as dictated by the third party system architecture.
   3. Integration shall be by RS-232 or RS-485 technologies.

C. Verify and diagnose communication messages and point information between third-party controllers and the BCS.

D. The BCS shall be able to monitor and control third-party controller point inputs and outputs as defined in the I/O point schedule.

2.07 INSTRUMENTATION

A. Temperature Sensors/Transducers.
   1. Provide only one of the following temperature sensor types throughout:
      a. 1000-ohm, (0.2%) thin film platinum.
      b. 100-ohm, (0.2 ohm) platinum.
      c. 1000-ohm, (0.2%) nickel.
      d. Thermistor (100 or 1000 ohm)
   2. All temperature sensors shall be constructed as follows:
      a. Shielded cable with a single end grounded.
      b. Waterproof sensor to sheath seal.
      c. Strain minimizing construction.
   3. All sensors provided shall meet the following overall end-to-end accuracy requirements whether or not temperature transducers are provided, under all normal building ambient conditions:
      a. Temperatures less than 100ºF shall be reported by the BCS with an accuracy of 0.5ºF.
      b. Temperatures greater than 100ºF shall be reported by the BCS with an accuracy of 1.0ºF.
      c. Averaging temperature sensors shall be reported by the BCS with an accuracy of 1.0ºF.
      d. Drift shall not exceed the accuracy requirements over a 5-year period.
   4. Thermowell mount elements shall meet the following additional requirements.
      a. Stainless steel sheath suitable for the pressure rating of the system.
      b. Length shall be suitable for application.
      c. Furnish thermowells and all other accessories required for the temperature sensor. The Mechanical Installer shall supply Wells for installation. Thermowells shall be stainless steel or chrome plated brass construction of size to suit sensor and pipe and shall be rated for the maximum pressure imposed on the various water systems. Verify and certify that the material of construction will not cause any galvanic corrosion.
      d. Each chilled or hot water supply temperature sensor shall be matched to within 0.2ºF over the range of 32ºF to 68ºF with the associated return water temperature sensor.
   5. Outside air temperature sensor shall meet the following additional requirements:
      a. Complete with non-corroding outdoor shield designed to minimize the effect of solar heating on the temperature sensor element.

b. Water proof seal.
c. Threaded fittings for mating to conduit.
d. Outside air temperature sensors shall be wired to different NCP. If one sensor or the associated NCP fails the other shall automatically take its place so that sequences of operation that are dependent on this parameter continue to be executed. Sensors shall be located as approved by the Architect/Engineer.

6. Duct mounted temperature sensors shall meet the following additional requirements:
   a. Copper sheathed construction.
   b. Length shall be such that the element is between 1/3 and 2/3 the distance across the duct from all sides.
   c. Ascertain the recommended location of supply air temperature sensors from the air handling unit manufacturer.
7. Space temperature sensors for all lobbies, public spaces and mullions shall meet the following additional minimum specifications:
   a. Sensor shall be flush mounted plate type with no local adjustment, located as directed by the Owner.
   b. The Owner shall approve color of sensor.
   c. Temperature sensors/operators will not be adjustable by occupants or have a display in common areas unless directed by the Owner.
      1) Provide Siemens QMX series temperature sensors.
8. Provide averaging temperature sensors where duct mounted temperature sensors are used to sense mixed air temperature or coil discharge temperature and the cross-sectional area of the duct is 12 square ft. or greater. Averaging temperature sensors shall meet the following requirements:
   a. Copper sheathed construction. Standard conduit box termination. Lead connections shall be rugged.
   b. Probe shall have a minimum-bending radius of 12 in.
   c. Probe shall have a minimum immersion length of 12 ft. or a minimum length of one foot per square foot of duct, whichever is greater.
   d. Probe shall be single continuous sensing RTD or shall be multiple RTD or thermistor sensors spaced no further apart than 6 in.
   e. Provide suitable supports at all bends and elsewhere as necessary to ensure that the sensor is held firmly in position and will not incur damage from vibration in the air stream. Support shall be provided, at minimum, every 24 in. in addition to support at bends.
9. If required, RTD temperature transducers to be provided having the following minimum specifications:
   a. Input circuit to accept resistance detectors as specified above.
   b. Output signal of 4-20mA into maximum of 500-ohm load. Output signal shall be proportional to the engineering range detailed in the Point Sheets.
   c. Output short circuit and open circuit protection.
   d. Input short circuit and open circuit protection.
   e. Output variation of less than 0.2% of full-scale output for supply voltage variations of 10%.
   f. Combined non-linearity, repeatability and hysterisis effects not to exceed 0.5% of full-scale output.
   g. Maximum current to sensor not to exceed manufacturers suggested rating.
   h. Integral, accessible zero and span adjustments.
   i. Long term output drift of equal to or less than 0.50% of full-scale output per year.
   j. Shock and vibration protection as necessary.

B. Humidity Sensors/Transducers
   1. Provide outside air, space and duct mounted relative humidity sensors and transducers having the following minimum specifications:
      a. Range of 0 - 100% RH.
      b. Combined "end-to-end" accuracy of sensor and transducer, 5% RH between 20% and 80% RH and 6% RH over full range.
      c. Maximum sensor non-linearity of 5% RH with defined curve. Transducer to provide linearized output.
      d. Output from transducer shall be 4-20 mA into a maximum of 500-ohm load.
      e. Output variations of less than 0.2% of full-scale output for supply variations of 10%.
      f. Maximum output linearity error of 1% if full scale output.
      g. Integral accessible zero and span adjustments.
      h. Long term output drift of less than 0.25% of full-scale output per 6 months.
      i. Dustproof housing.
      j. Outside air sensor shall be complete with non-corroding outdoor shield designed to minimize the effect of wind or solar heating on the RH sensing element (outdoor only).
      k. Suitably sized conduit to be provided for any lead wires external to the building or passing through the wall of the building (outdoor only).
      l. Duct mounted sensor shall have a minimum 8 in. probe.

C. Control Relays
   1. Provide interposing control relays having, at minimum, the following specifications:
      a. Pickup rating time and hold rating as required for individual applications.
      b. Input operating voltage to be compatible with the BCS digital output equipment.
      c. Shock and vibration protection as necessary.
      d. Rated for a minimum of ten (10 million mechanical operations and a minimum of 500,000 electrical operations.
   2. The control relays shall be located in the NCP or other local panels as provided by the BCS Installer.
   3. The relays shall provide complete isolation between the motor starter, damper actuator or valve actuator, control circuit and the associated BCS digital output.
   4. Select control relays such that they meet the following requirements.
      a. The malfunction of an NCP/ASC component shall cause the motor to fail on or off or maintain previous status as identified in the Sequences of Operation.
      b. Following the resumption of power after power interruption to a motor, the motor shall not restart until commanded to do so by the BCS in accordance with a predetermined start-up procedure.
      c. If a motor is detected by the BCS to have failed, i.e. its BCS monitored and commanded status differ, then the BCS shall shut down the motor and restart shall only be possible (when the HOA switch is in the "Auto") by a manually entered restart command at the BCS.
   5. Where hand-off-auto (HOA) switches are provided, the BCS digital output shall be wired such that control of the motor is from the BCS in the auto position only.
   6. Other interlocks providing safety control, e.g. shutdown on high temperature/vibration detection, etc., shall not be overridden by the BCS control relays or the installation of the control relays.

D. Differential Pressure Transducer - Air Service
   1. Provide supply static differential pressure transducers as follows:

a. Pressure transducers shall monitor the difference supply duct static pressure and space static pressure. The sensing point in the duct shall be as identified in the sequences of operations. The sensor shall be mounted adjacent to the sensing point in the duct.
b. Internal materials of the transducer shall be suitable for the application.
c. Output signal of 4-20mA proportional to input pressure, into a 500 ohm load.
d. Input range of 0 to 5 in.
e. Output variations of less than 0.3% full scale for supply voltage variations of 10% W.C.
f. End-to-end accuracy not to exceed 1.0% over entire range.
g. Integral, accessible zero and span adjustment.
h. Over pressure input protection to a minimum of five times rated input.

E. Differential Pressure Transducer – Water Service
1. Provide a differential pressure transducer meeting the requirements detailed herein to monitor the differential pressure across the supply and return lines of the chilled water and hot water systems.
2. The differential pressure transducers shall meet the following specifications:
a. Internal materials of the transducer shall be suitable for the application.
b. Output signal of 4-20mA proportional to input pressure, into a 500 ohm load.
c. Input range of 0.50 psig.
d. Output variations of less than 0.3% full scale for supply voltage variations of 10%.
e. End-to-end accuracy not to exceed 1.0% over entire range.
f. Integral, accessible zero an span adjustment.
g. Over pressure input protection to a minimum of five (5) times rated input.
h. The differential pressure transducer shall be rated to withstand the maximum rated pressure of the chilled water or hot water system in which it is installed.
i. The Mechanical Installer shall install valved tappings. Furnish the valves to the Mechanical Installer.

F. Differential Pressure Switches - Air Service
1. Provide differential pressure air switches as follows:
a. SPDT switch action or two (2) SPST switches rated for 10 amps minimum at 120 Vac.
b. Set point trip adjustment over, at minimum, of operating range. Dead band adjustment down to, at maximum, 10% of operating range.
c. Operating range of 1.0 in. W. C. to 3.0 in. W. C. for fans with a total static pressure rating of 2.5 in. W. C. or less and 2.0 in. W. C. to 6.0 in. W. C. for fans having a total static pressure rating of greater than 2.5 in. W. C. Operating range of 0 to 1.0 in. W. C. for filter status applications.
d. Shock and vibration protection as necessary.
e. Materials and construction suitable for application.
f. Manual reset shall be provided for air differential pressure switches used in high positive and negative pressure output applications. High differential pressure switches shall be provided for all VAV AHU.
g. Air differential pressure switches used in filter status applications shall be equipped with an analog gauge. Gauge shall indicate actual differential pressure and differential pressure set point of switch.
2. High differential pressure switches shall be wired in series with other safety devices to the respective motor starter.

G. Freezestats

1. Provide freezestats with a minimum 20-ft. vapor tension element, which shall serpentine, the inlet face on all air handling unit cooling which receive unconditioned outside air. One or more of these devices shall be provided and wired in series in order to provide one linear foot of coil surface area.
2. The freezestats shall have a manual reset. It shall not be possible for the switch to reset until the duct temperature has increased by at least 10ºF above the set point.
3. Hardwire interlock to the associated fan so that fan will shut down when HOT switch is in Hand or Auto position. Provide time delay relays with minimum two (2) minute time delay duration to minimize nuisance freezestats trips.
4. Cut out temperature shall be adjustable in the range of, at minimum, 32ºF to 40ºF.
5. Location shall be after heating coil and prior to cooling coil.

H. Current Sensing Relays
1. Provide current sensing relays as follows:
   a. Solid core current transducer.
   b. Switching range suitable for the application.
   c. Self-powered transducer.
   d. Normally open status contacts.
   e. Hysteresis amperage of no less than 0.2 amps.

I. Current-To-Pressure Transducer
1. Provide, current-to-pressure transducers as follows:
   a. Internal materials of the transducer suitable for continuous contract with industrial standard instrument air.
   b. Output signal of 3-15 psig proportional to input current.
   c. Input signal of 4-20 mA with a maximum input impedance of 500 ohms.
   d. Standard operating air pressure shall be 20 psig, not to exceed 30 psig.
   e. Air consumption shall not exceed 0.101 scfm at 15-psig supply.
   f. Combined non-linearity, repeatability and hysteresis not to exceed 2.0% of full-scale output over entire range.
   g. Operating temperature range of 32ºF to 100ºF with 5-90% RH (non-condensing).
   h. Dustproof housing.
   i. Shock and vibration protection as necessary.

J. Restrictors
1. Provide on-line restrictors, between damper and valve actuators and transducers, where necessary, to ensure a smooth and orderly operation of actuators as follows:
   a. Suitable for ambient temperatures to 120ºF at a minimum.
   b. Pressure rating of a minimum of 50 psi.
   c. Material of construction suitable for instrument air services.
   d. Orifice suitably sized for application. Where doubt exists as to required orifice size install restrictor having an adjustable orifice.

K. Current-To-Pressure Switch
1. Provide current-to-pressure switch as follows:
   a. Input switching range of 24-28 Vac or 28 Vde.
   b. Three port with two-position operation.
   c. Maximum power consumption of 20 watts.
   d. Provide all connections necessary between these switches, the BCS and the controlled end devices.
   e. Operable ambient temperature range of, at minimum, 20ºF to 120ºF with 5% to 90% RH (non-condensing).

f. Internal materials suitable for continuous contact with commercial standard instrument air.
g. Protective housing.
h. Shock and vibration protection as necessary.

L. Pressure-To-Current Transducers
1. Provide pressure-to-current transducers as follows:
a. Internal materials of the transducer suitable for continuous contact with industrial standard instrument air.
b. Output signal of 4-20 mA proportional to input pressure, into a maximum of 500 ohm load.
c. Output variations of less than 0.2% full scale for supply voltage variations of 10%.
d. Combined non-linearity, repeatability and hysteresis effects not to exceed 0.5% of full-scale output over entire range.
e. Integral, accessible zero and span adjustment.
f. Operating temperature range of 20ºF to 120ºF with 5-90% RH (non-condensing).
g. Temperature effect of 1.5% full scale/120ºF or less.
h. Over pressure input protection to a minimum of twice the maximum working input pressure.
i. Dustproof housing.
j. Shock and vibration protection as necessary.
k. Input range of 0 to 20 psi.
2. Control Air Pressure Reducing Station.
3. Provide control air pressure reducing stations as follows:
a. Inlet pressure rating up to 150 psig.
b. Outlet regulated pressure of 0 to 25 psig by locking setscrew.
c. Safety pressure relief.
d. Coalescent type oil removal filter. Filter shall be replaceable cartridge type capable of removing contaminants of 5-micron diameter or greater.
e. Automatic moisture removal trap with manual override.
f. 0 to 30-psig pressure gauge on outlet side of pressure reducing valve.
g. Isolation valves on each side of pressure reducing station to facilitate removal.

M. Fan Inlet Velocity Sensors/ Duct and Plenum Probes
1. Sensors shall be of the thermal dispersion type with true average, independent multi-point sensing capability. Sensors shall be totally constructed from non-corrosive materials, with 304 stainless steel sensor bodies, 304 stainless steel mounting brackets, adjustable cadmium-plated muting rods and "bead in glass" thermistor sensors. Each fan airflow monitoring system shall incorporate at least two sensor probes with four thermistors each.
2. Fan Inlet Performance Requirements – The individual sensor accuracy for airflow shall be better than ±0.15ºF (±0.1ºC) over the entire operating range.
3. Fan Inlet Sensor Operating Ranges – Airflow: 0 to 10,000 FPM; Temperature: -20ºF to + 160ºF; Relative Humidity: 0 to 99% (non-condensing).
4. Transmitter shall be constructed of an aluminum chassis designed to operate between minus 20ºF and 120ºF. Transmitter shall be equipped with a 12-bit A/D converter with a minimum reading accuracy of 2%. Transmitter shall output a 4-20 mAdc or 0-10 Vdc signal proportional to air velocity.
5. Approved manufactures and equipment shall include only the following:

a. Ebtron Advantage III Gold Series probes, combination airflow/ temperature sensors with GTx116-F (Duct and Plenum Probe) or GTx108-F (Fan Inlet Sensor) transmitter as appropriate.
b. No substitutions.

N. CO2 Sensors
1. Sensors shall be wall-mounted, of the non-dispersive infrared type, for measuring environmental CO2 concentration. Sensors shall measure accurately from 0-2000 ppm. Sensor to be equal to Veris Industries model CWE (for wall-mounted CO2 sensor applications) or Veris Industries model CRLSXX (for duct-mounted CO2 sensor applications) as appropriate.

2.08 AUTOMATIC VALVES - GENERAL

A. Furnish all valves shown on the Mechanical Drawings and/or described in the sequences of operation as automatic control valves. The Mechanical Installer shall install valves. All other valves such as check valves, relief valves, pressure reducing valves, self-regulating valves, manually operated valves, etc. shall be furnished and installed by the Mechanical Installer. Provide details of the manufacturer's installation requirements to the Mechanical Installer. Refer to the mechanical drawings for the design conditions on which to base sizing and ratings of the valves and their actuators.

B. All valves shall be in accordance with ANSI B16.10, and ANSI B16.34 as appropriate and all other applicable standards. At minimum, valves shall meet ANSI Class 150 ratings and valves detailed to have minimum working pressure ratings in excess of 150 psig shall, at minimum, meet ANSI Class 300 ratings. Where there is a conflict between ANSI, and other applicable standards, the most stringent shall apply. All valves shall be tested to a minimum of 1.5 times the maximum working pressure rating.

C. Valves shall have the manufacturer's name and the pressure rating clearly marked on the outside of the body. Where this is not possible manufacturer's name and valve pressure rating shall be engraved on a minimum 2-in. diameter stainless steel tag that shall be attached to the valve by a chain in such a manner that it cannot be unintentionally removed.

D. Valves up to 2 in. in size shall have screwed ends. Valves 2.5 in. and larger shall have flanged ends. Flanged valves shall be furnished complete with companion flanges, gaskets and bolting materials. Flanges, gaskets and boiling materials shall meet the requirements of ASME/ANSI B16.3, B16.5, B16.9, B16.11 and all other relevant standards.

E. Valves shall be suitable for continuous throttling. Control valves shall be selected so that cavitation does not occur over the full operating range of the valve at the system differential pressures. The control valve assembly shall be capable of tight shut-off when operating at system pressure with the system pump operating at shut-off head.

F. Valve schedules shall be submitted for review and shall clearly show the following for each valve:
1. Associated system.
2. Manufacturer and model number.
3. Size.
4. Flow rate, flow coefficient – (CV) and pressure drop at design conditions.
5. Valve configuration (e.g. two way, three way, butterfly).
6. Leakage rate.
7. Maximum pressure shut-off capability.
8. Actuator manufacturer and model number.
9. Valve body pressure and temperature rating.

10. Normally open/closed and failure positions.

G. Control Valves
   1. Two-way control valves shall be full-port ball-valve type suitable for chilled and hot water service. These valves shall meet the following minimum requirements:
      a. Modulating design to provide equal percentage flow characteristics.
      b. Leakage rate shall not exceed 0.01% of the value flow coefficient (CV) at pump shut-off head.
      c. The valves shall be rated at minimum for the working pressures indicted in the valves schedules.
      d. Valves shall be suitable for continuous throttling.
      e. Valve body material shall be bronze, with stainless steel trim for working pressures below 300 psig.
      f. Valve seats, and stem packing shall be Teflon or equivalent and must assure tight seating.
   2. Three-way valves shall be suitable for chilled water and hot water service and shall meet the following minimum requirements.
      a. Modulating design with V-port parabolic or linear plug and stainless steel trim.
      b. Leakage rate shall not exceed 0.01% of the valve CV from inlet to an outlet port at pump shut-off head when this valve is closed to flow through that outlet port.
      c. Valve body material shall be cast iron or carbon steel with stainless steel trim.
      d. Valve seats shall be metal, ceramic filled PTFE or equivalent and must assure tight seating.
   3. Pressure drop through modulating control valves shall not exceed 8 psig, including any reducing fittings used.

H. Valve Actuators
   1. All valves shall be provided with electric actuators. Actuators shall be sized to meet the shut-off requirements when operating at the maximum system differential pressure and with the installed system pump operating at shut-off head. Actuators shall control against system maximum working pressures.
   2. All two-way and three-way control valves on cooling and heating coils shall fail open upon a loss of power, or as indicated in the Sequences of Operation. The three-way control valves shall fail open to flow through the coil. Butterfly valves shall fail in the previous position.
   3. Actuators shall have visual mechanical position indication, showing output shaft and valve position. The actuator shall be capable of operating the valve from the fully closed to the fully open position and vice versa in less than two minutes.
   4. Actuators shall be constructed to withstand high shock and vibration without operations failure. The actuator cover shall be die cast aluminum or material of equivalent strength and have captive bolts to eliminate loss of bolts when removing the cover from the base. Materials of construction shall be non-corroding.
   5. Actuators and valves shall be mounted and installed only in the positions approved by the manufacturer. Shop drawings shall clearly indicate the acceptable positions.
   6. Valve actuators shall be of the magnetic or motor driven type. Valve stem position shall be adjustable in increments of one (1) percent or less of full stem travel.
      a. Motor driven actuators shall have an integral self-locking gear train, mechanical travel stops and two adjustable travel limit switches with electrically isolated contacts; gear assembly shall be made of hardened steel. Motor drive actuators shall be rated for continuous duty and have an input voltage of 24 volts, 60 Hz.

Disassembly of the gears shall not be required to remove the motor. Actuator motor shall be fully accessible for ease of maintenance.

b. Magnetic actuators shall be rated for continuous duty and shall have a control signal compatible with the analog output subsystem.

2.09 DAMPERS - GENERAL

A. Furnish all automatic dampers (AD), as indicted on the Mechanical Drawings. Fusible link dampers for fire protection (FD), smoke dampers (SD) fire smoke dampers (FSD), and manual dampers (MD) for balancing, back draft dampers (BD) and dampers which are specified as part of a factory built air handling unit or terminal unit are not furnished by the BCS Installer. The Mechanical Installer shall install all dampers. Provide details of the manufacturer's installation requirements to the Mechanical Installer.

B. Provide damper actuators for all dampers that are furnished as part of this Contract. Where practical actuators shall be factory mounted.

C. Dampers incorporating multiple sections shall be controlled in unison. Where more than one actuator serves a damper, then the actuators shall be driven in unison and the control wiring shall be provided accordingly. Damper sections shall not exceed sixteen (16) square ft. in face area. Damper jackshafts are not acceptable for controlling multiple damper sections.

D. Dampers incorporating multiple sections shall be designed in such a way that the actuators, whether externally or internally mounted, are accessible without difficulty. Under no circumstances shall it be necessary to remove damper sections, or structural or other fixtures to facilitate removal of damper motors. Provide access doors where necessary to meet this requirement. In particular ensure that where in-air stream actuators are provided they are readily accessible.

E. For all AD, FSD, and SD that are interlocked to a fan motor(s), the BCS Installer shall wire between the MCC or local starter and the damper actuator. Dampers interlocked to fan motors shall be driven open and spring closed unless otherwise indicated in the Contract Documents. The 120 Vac power supply originating from the MCC or local starter shall be used to power the damper where possible. If the damper is indicated to be spring open and driven closed or requires a separate power source then the BCS Installer shall provide the necessary interposing relays and shall obtain the power supply to hold the damper closed from the nearest available power panel. The BCS Installer shall wire between the AD, FSD or SD position indicator switch, whose contacts shall be rated for a load up to 10 amps at 120 Vac, and the MCC or local starter. The damper position indicator switch contacts shall be closed when the damper is fully open and open when the damper is not fully open. The Fire Alarm System control of interlocked dampers shall be via the fan motor starter.

F. Automatic Dampers

1. Automatic Dampers (AD) shall be factory fabricated.
2. Damper frames shall be constructed of 16-gauge thick welded galvanized steel channel, or 1/8 in. thick extended aluminum channel. Frames in excess of 3 ft. by 3 ft., shall have corner braces or equivalent means of strengthening to ensure squareness and rigidity. Channel dimensions shall be a minimum of 5 in. by 1 in. 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. The BCS Installer shall be responsible for coordination of correct sizing for damper assemblies furnished as part of this Contract. Blade stops shall not extend more than 1/2 in. into the air stream.

3. Damper blades shall be constructed of:
    a. Galvanized sheet steel of minimum 21-gauge thickness with a minimum of four (4) breaks running the entire length of the blade.
    b. Double galvanized sheet steel of minimum 22-gauge thickness per sheet. Sheets shall be formed with a minimum of four (4) breaks in each sheet running the entire length of the blade. Sheets shall be spot welded together, or
    c. Airfoil shaped double skin-galvanized steel constructed from minimum 14-gauge thick galvanized sheet steel.
    d. Airfoil shaped double skin-extruded aluminum constructed from minimum 16-gauge thick sheet.
4. Maximum width for galvanized steel blades shall not exceed 8 in. and for aluminum shall not exceed 6 in. Maximum blade length shall not exceed 48 in.
5. Blade edge seals shall be field replaceable and shall be one of the following:
    a. Neoprene
    b. Vinyl
    c. Polyurethane
    d. Silicone rubber
    e. Synthetic elastomer
6. Blade end (side) seals shall be one of the following:
    a. Continuous spring stainless steel strip
    b. Synthetic elastomer
    c. Flexible aluminum compression type.
7. Damper sections shall be installed such that the blades are horizontal.
8. Damper axles shall be constructed of:
    a. Minimum 1/2 in. square zinc plated steel with non-slip between blade and axle.
    b. Minimum 1/2 in. hexagon zinc plated steel with non-slip locking between blade and axle.
    c. Minimum 1/2 in. diameter zinc plated steel fastened to the blades with bolts through the axle, rivets or welds to ensure non-slip locking between blade and axle.
9. Damper axle bearings shall be one of the following:
    a. Oil impregnated sintered bronze
    b. Stainless steel sleeve
10. Linkage that interconnects blades shall be corrosion resistant steel and shall be located on the face of the damper in the air stream or shall be concealed in the frame. Linkages shall be readily accessible for maintenance.
11. Control shaft shall be as specified above and shall extend beyond the frame as necessary to match up with actuator or actuator linkage as applicable.
12. Modulating dampers shall be of the opposed blade type. Two position dampers shall be of either the parallel or opposed blade type.
13. Multiple section dampers shall bolt together to form a rigid structure free from twisting or bending.
14. The two diagonal measurements from upper to lower opposite corners of the installed damper assembly, including multiple section dampers, shall not differ by more than 0.15 in. or 0.2 percent, whichever is greater.
15. The free area ratio, i.e. the open area in a damper assembly, including in-air stream actuators, divided by the total duct area shall not be less than 0.75 for velocities above 1500 fps and 0.6 for velocities below 1500 fps. This shall apply to both single and multiple damper section assemblies.

16. Maximum leakage rate through a 48 in. by 48 in. closed automatic damper shall not exceed 10 CFM per square foot of overall damper face area at 4 in. W.C. pressure differential with a maximum closing torque not exceeding that applied by the actuator provided for the damper. The leakage rate of the field-installed damper shall not exceed the rate specified above. Dampers shall be rated for the maximum air stream face velocity that they will experience during normal operation.
17. Damper schedules shall be submitted for review and shall clearly indicate the following for each damper:
    a. Associated system.
    b. Manufacturer and model number.
    c. Mechanical drawing reference.
    d. Damper size for each section.
    e. Parallel or opposed blade configuration.
    f. Actuator manufacturer and model number for each section.
    g. Ratio of anticipated air stream velocity to the manufacturer's maximum recommended velocity rating.
    h. Free area ratio.
18. If the automatic damper complies with these specifications, one of the following manufacturers will be acceptable:
    a. Greenheck
    b. Pottorff
    c. Ruskin

2.10 DAMPER ACTUATOR

A. Damper Actuators.
1. Provide damper actuators for all automatic control dampers, including those furnished as part of a packaged air-handling unit.
2. Electric damper actuators used for two-position service shall be of the spring return type. Modulating dampers shall be motorized in both directions with spring return to the failure (de-energized) position. Unless stated otherwise in these Contract Documents dampers shall fail to the closed position on loss of power. Damper actuators shall have a service life, at minimum, of 60,000 fully closed to fully open to fully closed operations. In addition the modulating damper actuators shall have a service life of, at minimum, 1000 spring operations on loss of power.
3. Actuators shall stroke by the rotating motion of a reversible, overload-protected synchronous motor or shall be direct-coupled rotary type actuators.
4. The actuators shall be protected against overload by an integral magnetic clutch that shall allow the motor to continue running when, for example, the actuator is stalled at the end of its stroke or by a jammed damper. Alternatively, stall protection shall be by non-overloading impedance protected motor.
5. Provide sufficient quantity of additional damper actuators to meet the damper leakage requirements for the installed damper assembly. At minimum the torque provided shall be such as to meet the maximum close-off leakage requirements.
6. Provide mounting brackets suitable for extended shaft mounting or direct damper drive shaft mounting. The actuator housing shall be rugged and non-corrosive.
7. Damper actuator shall be fully accessible for ease of maintenance. Shop drawings shall clearly indicate motor locations on multiple section damper assemblies.
8. The actuators shall stroke two position dampers from fully closed to fully open in less than two (2) minutes. Modulating dampers shall be driven from fully closed to fully open and vice versa in less than two (2) minutes. This time shall not include the initial

period following the availability of power, not to exceed 200 seconds, which is required to tension the spring.

9. The control signal to the modulating damper actuators shall be compatible with the BCS analog output subsystem e.g. 4-20 mA, 0 to 10 Vdc, etc.
10. Actuators shall be as manufactured by Belimo.

PART 3 - EXECUTION

3.01 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 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.

3.02 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.

3.03 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.

3.04 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.

3.05 TRAINING

A. Provide a minimum of 40 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.

B. Provide a paid tuition for one student to attend a minimum 5-day factory-training course at the BCS manufacturer's training facility.

3.06 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 23 09 23

SECTION 23 09 93 - SEQUENCE OF OPERATION

PART 1 - GENERAL

1.01 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".

1.02 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.

1.03 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

2.01 VARIABLE VOLUME AIR HANDLING UNITS

A. Each of these units is a dual zone, variable volume air handling unit, draw through type equipped with variable speed supply fan, outside damper, return air damper, relief air damper, chilled water cooling coil and hot water preheat coil.

B. De-energized Mode.
   1. Supply fan shall be de-energized.
   2. Outside air damper shall be closed.
   3. Hot water preheat coil valve shall be closed to the coil.
   4. Electric preheat coil shall be de-energized.
   5. Chilled water-cooling coil valve shall be closed to the coil.
   6. Relief air damper shall be closed.

C. Preheat Mode
   1. The preheat coil valve shall open to flow through the coil sixty (60) seconds prior to fan start.
   2. The freeze protection sequence shall be disabled for an Operator defined time period.

D. Economizer Mode
   1. Supply fan shall be energized.
   2. The BCS shall compare the outside air enthalpy and the return air enthalpy and shall modulate the outside air damper and return air damper to provide the lowest heat content air to the air handling unit.
   3. If the mixed air temperature is below 40°F, the outside air damper shall close to the minimum outside air position.
   4. When the outside air enthalpy is lower that the return air enthalpy, but the supply air temperature setpoint cannot be satisfied, then the chilled water cooling coil control valve shall be modulated to provided supplemental cooling as needed to maintain the supply air temperature setpoint.
   5. If the outside air enthalpy is higher than the return air enthalpy, the AHU shall operate under the normal operation mode.
   6. The relief air damper 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.

7. Preheat coil valve shall be modulated to maintain a preheat temperature setpoint of 45°F.
8. Provide auto on off software function such that the Operator can override the economizer cycle operation from the associated VDU graphic.
9. Provide an Operator adjustable deadband between the economizer and normal operating modes, initially set at 4°F.

E. Normal Operation Mode.
1. Supply fan shall be energized.
2. Outside air damper shall open to the minimum outside air position.
3. Cooling coil valve shall be modulated to maintain the supply air temperature setpoint, initially set at 55°F.
4. Preheat coil valve shall be modulated to maintain the preheat temperature setpoint of 45°F.
5. The relief air damper shall be modulated by the BCS to maintain the return air static pressure setpoint. Coordinate exact return air static pressure setpoint and sensor location with the Test and Balance Contractor.
6. Supply fan speed shall be modulated by the BCS to maintain the supply duct static pressure setpoint. Coordinate the exact duct static pressure sensor location and static pressure setpoint with the Test and Balance Contractor.

F. Freeze Protection Mode
1. Upon a preheat temperature of 37°F., an alarm shall be generated by the BCS.
2. Upon a preheat temperature of 35°F., the BCS component failure mode shall be initiated.
3. Upon a freezestat trip, the BCS component failure mode shall be initiated. The freezestat trip setpoint shall be 35°F.

G. BCS Component Failure Mode
1. Supply fan shall be de-energized.
2. Outside air damper shall be closed.
3. Cooling coil valve shall be open..
4. Preheat coil valves shall be open.
5. Electric preheat coil shall be de-energized.
6. Relief air damper shall be closed.
7. Return air damper shall be open.
8. Generate an appropriate alarm.

H. Pressure differential switches with manual reset, located in the mixed air and discharge plenums shall be hardwire interlocked with these units to shut down the supply air fans in the event of a high or low differential pressure.

PART 3 - INSTALLATION - NOT USED

END OF SECTION 23 09 93

SECTION 23 21 13.23 - HYDRONIC PIPING

PART 1 - GENERAL

1.01 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. Heating Water.
   2. Chilled Water.
   3. Miscellaneous Drain Lines.

1.02 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. UMC Compliance: Fabricate and install hydronic piping in accordance with ICBO "Uniform Mechanical Code".
   3. IMC Compliance: Fabricate and install hydronic piping in accordance with "International Mechanical Code."

1.03 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.

PART 2 - PRODUCTS

2.01 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.

2.02 BASIC PIPES AND PIPE FITTINGS

A. Hydronic Piping:
   1. Tube Size 3 in. to 3/4 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.
   2. 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.
   3. 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.

2.03 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. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, and water impervious isolation barrier.

2.04 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, 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) Watts B-6080, B-6081
         2) Jomar T-100-SS
         3) Apollo 77-100 Series
         4) Nibco T-585-70-66
   2. Ball valves 2-1/2 in. and greater: MSS SP-72, rated for 200 psig minimum water pressure, full port, cast iron, bronze or stainless steel body, 316 or 304 stainless steel ball and stem, reinforced Teflon seats and seals, 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 6PLF
         2) Crane KF 953
         3) Jomar T-100-SS (NPT) or FL-CS-100-150 (FLANGED)

4) Watts G 4000
5) Nibco T-585-70-66

B. Check Valves
1. Check valves 2 in. and less: MSS SP-80, rated for 200 psig minimum water pressure, swing type, bronze body and disc, renewable seat disc, threaded cap, threaded connections.
a. Acceptable Manufacturers and Models:
1) Apollo 163T/S
2) Crane 37
3) Jomar T/S-511
4) Stockham B-319
5) Milwaukee 509
6) Nobco T-413-Y
2. Check valves 2-1/2 in. and greater: MSS SP-71, rated for 200 psig minimum water pressure, swing type, iron body bronze mounted, bolted cap, flanged connections.
a. Acceptable Manufacturers and Models:
1) Apollo 910F
2) Crane 373
3) Stockham G-931
4) Milwaukee F2974
5) Nibco F-918-B

PART 3 - EXECUTION

3.01 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.

3.02 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. Connect branch-feed piping to mains at horizontal centerline of mains; connect run-out piping to branches at horizontal centerline of branches.
4. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.
5. Install dielectric connections wherever joining dissimilar metals.

3.03 INSTALLATION OF VALVES

A. Provide ball valves for shutoff service as follows:
1. On each branch riser, close to main, where branch or riser serves 2 or more hydronic terminals or equipment connections, and elsewhere as indicated.
2. On inlet and outlet of each mechanical equipment item, and on inlet of each hydronic terminal, and elsewhere as indicated.
3. 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 ball valves for throttling service as follows:
   1. On outlet of each hydronic terminal, and elsewhere as indicated.

C. Provide check valves on discharge side of each pump, and elsewhere as indicated.
   1. Horizontal swing check valve shall be installed in a true horizontal position.

3.04 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.

B. Hydronic Terminals: Install hydronic terminals with hydronic terminal outlet valve and union on outlet; union, shutoff valve on inlet. Install manual air vent valve on element in accordance with manufacturer's instructions. Locate valves and balancing cocks behind valve access doors for ease of maintenance. Where indicated, install automatic temperature control valve with unions between gate valve and element on supply line.

3.05 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 for a minimum of 10 minutes. 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.

3.06 CLEANING

A. Cleaning, Flushing and Inspecting: Flush new and distrubed existing 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.

3.07 TESTING, ADJUSTING AND BALANCING

A. Test, adjust and balance hydronic systems in accordance with requirements of Section 23 05 93.

END OF SECTION 23 21 13.23

SECTION 23 31 13 - METAL DUCTWORK

PART 1 - GENERAL

1.01 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.

1.02 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.

1.03 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.

1.04 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

2.01 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.

2.02 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 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.

D. 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.

E. 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.

2.03 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 and shall not be used for changes in direction.

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.

2.04 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. 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.

H. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division 23 Section "Ductwork Accessories" for accessory requirements.

I. 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. No fiberglass duct liner will be allowed.

J. 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.
3. 73 in. diameter and up, use companion angle flanged joints only as defined on page 3-6 of the SMACNA Manual. Refer to manual for proper sizing and construction details. Ductwall to be welded longitudinal seams.

K. 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.

2.05 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 Arlington Mechanical Code.

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

3.01 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.

3.02 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. Inserts: Install concrete inserts for support of ductwork in coordination with formwork, as required to avoid delays in work.

C. Field Fabrication: Complete fabrication of work at project as necessary to match shop fabricated work and accommodates installation requirements.

D. 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.

E. Electrical Equipment Spaces: Do not route ductwork through Electric Rooms, transformer vaults, and other electrical equipment spaces and enclosures.

F. 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".

G. Coordination: Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.

H. Installation: Install metal ductwork in accordance with SMACNA HVAC Duct Construction Standards.

3.03 INSTALLATION OF FLEXIBLE DUCTS

A. Maximum Length: For any duct run using flexible ductwork, do not exceed 6 ft. 0 in. extended length or utilize flexible ductwork for changes in direction.

B. Installation: Install in accordance with Section III of SMACNA's, HVAC Duct Construction Standards, Metal and Flexible".

3.04 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.

3.05 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.

3.06 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 23 31 13

SECTION 23 31 13.19 - DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.01 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. Fire and smoke dampers.
   3. Turning vanes.
   4. Duct hardware.
   5. Duct access doors.
   6. Flexible connections.
   7. Concealed Damper Regulators.

C. Refer to other Division 23 sections for testing, adjusting, and balancing of ductwork accessories; not work of this section.

1.02 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.

1.03 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

2.01 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. Control Dampers: Refer to Division 23 Section "CONTROL SYSTEMS": for control dampers; not work of this section.

D. 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.

E. 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.

2.02 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 single 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. Turning vanes shall be a prefabricated system.

C. Acoustic Turning Vanes: Provide acoustic turning vanes constructed of air-foil shaped aluminum extrusions with perforated faces and fiberglass fill.

D. The Owner will inspect installation of all turning vanes.

E. Manufacturer: Subject to compliance with requirements, provide turning vanes of one of the following:
   1. Aero Dyne Co.
   2. Ductmate Industries, Inc.
   3. Duro Dyne Corp.
   4. Semco

2.03 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.

2.04 DUCT ACCESS DOORS

A. General: Provide where indicated, duct access doors of size indicated.

B. Provide duct for access to fire dampers, turning vanes, and any other internal devices.

C. 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.

D. As an option, clamping type access doors may be installed.

E. 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.

2.05 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.

2.06 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. Location shall be indicated on as-built drawings.

PART 3 - EXECUTION

3.01 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.

3.02 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 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.

D. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

3.03 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.

3.04 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.

3.05 EXTRA STOCK

A. Furnish extra fusible links to Owner, one link for every 10 installed of each temperature range; obtain receipt.

END OF SECTION 23 31 13.19

SECTION 23 37 13 - AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.01 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. Linear slot diffusers

1.02 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.

1.03 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. Samples: Submit 3 samples of each type of finish furnished.

C. 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.

D. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop Drawings in maintenance manuals; in accordance with requirements of Division 01.

1.04 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

2.01 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.
   1. Grille Materials:
      a. Steel Construction (ST): Manufacturer's standard stamped sheet steel frame.
      b. Aluminum Construction (AL): Manufacturer's standard extruded aluminum frame.
   2. Grille Faces:
      a. 45 Degree Angle Blades (ABA): Blades parallel to long dimension, at manufacturer's standard spacing.
      b. Plastic Grid (PG): 1/2 x 1/2 x 1/2 plastic core.
      c. Aluminum Grid (AG): 1/2 x 1/2 x 1/2 aluminum core.
   3. Grille Dampers:
      a. Opposed Blade (O-B): Adjustable opposed blade damper assembly, key operated from face of register.
   4. Grille Finishes:
      a. Finish shall be off-white baked enamel.
      b. Color selection shall be from manufacturer's standard color chips.
      c. Color selection shall match architectural background; color chips or a painted sample device shall be submitted for approval.

E. Manufacturer: Subject to compliance with requirements, provide grilles of one of the following:
   1. Metalaire,
   2. Airmate,
   3. Titus,
   4. No Substitutions.

2.02 LINEAR SLOT DIFFUSERS

A. General: Except as otherwise indicated, provide manufacturer’s standard diffusers where shown; of size, shape, capacity and type indicated; constructed materials and components as

indicated, and as required for complete installation. Slot diffusers shall be constructed of aluminum with bi-directional, adjustable control vanes that shall be capable of deflecting the air pattern from horizontal along the ceiling, to straight down, or at an intermediate setting. Unit shall be so designed that when deflecting vanes are in the closed position, the air pressure tends to form a tight seal. Airflow rate can be varied without changing the air pattern. The set of vanes in the diffuser that controls the air pattern and flow rate shall perform these functions satisfactorily without the use of an additional damper. Each length of diffuser shall be capable of being installed without any visible means of fastening. Each length of diffuser shall have a self-aligning device permitting long lengths to be aligned without the aligning device visibly apparent.

B. Performance; Provide diffusers that have, as minimum, noise criteria ratings, pressure drop, and throw for each size device as listed in manufacturer's current data.

C. Ceiling Compatibility; provide diffusers with borders styles that are compatible with adjacent ceiling systems or for suspended mounting, 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 slot diffuser.

D. Types: Provide slot diffusers of type and with accessories as listed on grille schedule.
   1. Grille Finishes:
      a. Finish shall be white baked enamel, or primer as scheduled.
   2. Boot Plenums:
      a. Provide all slot diffusers with lined boot plenums with neck size equal to that shown in drawings on the run outs.

E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering diffusers which may be incorporated in the work include; but are not limited to, the following:
   1. Metalaire,
   2. Krueger,
   3. Nailor,
   4. Price,
   5. Titus,
   6. No Substitutions.

2.03 OPPOSED BLADE DAMPER

A. Provide opposed blade dampers for air devices as 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

3.01 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.

3.02 INSTALLATION

A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure 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. Locate ceiling air diffusers, registers, and grilles, as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling modules.

D. Flexible duct shall be the same diameter as the neck size of the diffuser.

3.03 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 23 37 13

SECTION 23 73 13 - AIR HANDLING UNITS

PART 1 - GENERAL

1.01 SUMMARY

A. Extent of air handling unit work is indicated on Drawings and schedules, and by requirements of this section.

B. Types of packaged air handling units specified in this section include the following:
   1. Indoor draw-through with VAV control.

1.02 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of packaged air handling units with characteristics, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than 10 years.

B. Codes and Standards:
   1. AMCA Compliance: Test and rate air handling units in accordance with AMCA standards 210 and 500.
   2. ARI Compliance: Test and rate air handling units in accordance with ARI 430 "Standard for Central Station Air Handling Units", display certification symbol on units of certified models.
   3. ASHRAE Compliance: Construct and install refrigerant coils in accordance with ASHRAE 15 "Safety Code for Mechanical Refrigeration", latest edition.
   4. NFPA Compliance: Provide air handling unit internal insulation having flame spread rating not over 25 and smoke developed rating no higher than 50; and complying with NFPA 90A Installation of Air Conditioning and Ventilating Systems", latest edition.
   5. UL and NEMA Compliance: Provide electrical components required as part of air handling units, which have been listed and labeled by UL and comply with NEMA Standards.
   6. NEC Compliance: Comply with National Electrical Code (NFPA 70) latest edition as applicable to installation and electrical connections of ancillary electrical components of air handling units.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for air handling units showing dimensions, weights, capacities, ratings, fan performance with operating point clearly indicated, motor electrical characteristics, gauges and finishes of materials, and installation instructions.

B. Shop Drawings: Submit assembly-type shop Drawings showing unit dimensions, weight loadings, required clearances, construction details, and field connection details.

C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to air handling units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

D. Maintenance Data: Submit maintenance instructions, including instructions for lubrication, filter replacement, motor and drive replacement, and spare parts lists. Include this data, product data; shop Drawings, and wiring diagrams in maintenance manuals; in accordance with requirements of Division 01.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver air-handling units with factory-installed shipping skids and lifting lugs; pack components in factory fabricated protective containers.

B. Handle air-handling units carefully to avoid damage to components, enclosures, and finish. Do not install-damaged components; replace and return damaged components to air handling unit manufacturer.

C. Store air-handling units in clean dry place and protect from weather and construction traffic.

D. Comply with Manufacturer's rigging and installation instructions for unloading air handling units, and moving them to final location.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide air handling units of one of the following:
   1. Temtrol
   2. Trane Custom
   3. Governair

2.02 AIR HANDLING UNITS

A. General: Provide factory-fabricated and factory-tested air handling units as indicated, of sizes and capacities as scheduled, and as specified herein.

B. Casings: Construct double-wall casings of galvanized steel (Outer 16 GA, Inner 18 GA)with internal insulating layer, maximum L/250 deflection, designed to withstand specific operating pressures. Provide casing panels and/or access doors that are easily and quickly removable for inspection and access to internal parts.
   1. Provide single zone units consisting of fan section, coil section, adjustable fan motor mounting, and drain pan.
   2. Provide reinforced points of support for either setting or hanging units.
   3. 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.
   4. Cover casing and frame with manufacturer's standard protective finish on both sides.
   5. Casing shall include a minimum of an R-16 internal insulating layer within the double-wall construction.

C. Coils: Provide heating and cooling coil(s) of scheduled capacity, mounted in unit in manner permitting removal.
   1. Construct coils with 5/8" outer diameter copper tubing primary surface and aluminum or copper secondary surface bonded to tubes by method approved by specified manufacturer. Provide chilled water and heating coils with threaded connections. Provide chilled water coils with drain and vent connections. Pitch coils in unit casing for drainage.

D. Coil Sections: Provide common casing for heating and cooling coil(s) as required. Design internal structure of coil section to allow for removal of coil(s), and provide suitable baffles to assure no air bypass around coil(s). Provide condensate pans and drain connections to cooling coil sections of sufficient size to contain and remove coil condensate. Insulate coil section casings and drain pans as specified in "Insulation" paragraph. For reheat coils,

make provisions to allow simultaneous dehumidification and reheating at maximum cooling face velocity catalogued by manufacturer.

E. Fan Sections: Provide type of fans scheduled specifically designed and suitable for class of service indicated. 7.5 HP maximum, per fan motor. Fans shall be direct drive. Provide adjustable motor base, adjusted with mounting bolts, to provide variation in center distance. Provide locking nuts, or similar devices, to secure base in proper position. Design fan shafts so as not to pass through first critical speed when unit comes up to rated RPM. Provide grease-lubricated fan bearings with externally accessible fittings for lubrication. Statically and dynamically balance fan assemblies in fan housing after final assembly.

F. Filter Boxes: Provide filter boxes with either hinged access doors or quickly removable panels, at each end. Provide racks to receive filters in flat type pattern.

G. Provide insulation with fire-retarding characteristics, complying with NFPA 90A. Insulate drain pans as required to prevent condensate formation on unit exterior at ambient conditions to be encountered.

H. Mixing Boxes: Provide mixing boxes of physical size to match basic unit, and include equal-sized-flanged openings capable of handling full airflow. Arrange openings as indicated. Provide dual action parallel blade dampers with sealing edges, arranged to operate automatically with one set of linkage. Provide dampers of balanced construction, rotating in centered bronze or nylon bearings.
   1. Provide dampers with leakage limited to 10-cfm/sq. ft. at 4 in. wg.

I. Air Filters:
   1. All air filters shall be listed as (Class 1, Class 2) in accordance with Underwriters Laboratories, Inc., Building Materials Director requirements, except ultra-high efficiency filters, (HEPA or ULPA,) shall be manufactured of materials that are so listed by UL. All filters other than the ultrahigh efficiency type are to be rated in accordance with ASHRAE Test Standard 52-76 and performance characteristics are to be published in the manufacturer's literature. When specified performance characteristics are not published in the manufacturer's literature, the submittal data shall include certified documentation of performance by an approved independent test laboratory.
   2. Type "D": Replaceable, Dry Type, Medium and/or High Efficiency (minimum MERV 13): Filters shall be 12" deep of the extended surface, supported pleat type. Each filter shall consist of high density, microfine glass fiber media, media support grid, contour stabilizers, and enclosing galvanized steel frame. Media shall be laminated to a nonwoven synthetic backing to form a lofted surface for maximum dust holding capacity. The edges of the media shall be continuously bonded to the internal surfaces of the galvanized steel frame to prevent bypass of unfiltered air. Filter efficiency shall average not less than (40 to 45%) (50 to 55%) (80 to 85%) (90 to 95%) when tested in accordance with ASHRAE Test Standard 52-76. Filters shall be 24" x 24" x 12" deep with an initial clean resistance not to exceed (0.25) (0.35) (0.50) (0.65) inches w.g. at 500 fpm face velocity. The filters shall be certified to have a dust holding capacity of not less than (700) (400) (235) (130) grams of ASHRAE Test Dust when operated at 500 fpm face velocity to an final resistance of 1" w.g.

J. Air Volume Control:
   1. Provide variable speed (frequency) drive as specified in Section 23 89 65.

K. The Contractor shall for each air handling system with 2000 CFM airflow (nominal 5 Tons) or greater, 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.

1. System airflow includes the total airflow of all units serving any space and all units connected to the same return air plenum.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which air handling units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF AIR HANDLING UNITS

A. General: Install air handling units where indicated, in accordance with equipment manufacturer's published installation instructions, and with recognized industry practices, to ensure that units comply with requirements and serve intended purposes.

B. Coordination: Coordinate with other work, including ductwork, floor construction, roof decking, and piping, as necessary to interface installation of air handling units with other work.

C. Access: Provide access space around air handling units for service as indicated, but in no case less than that recommended by manufacturer.

D. Support: Install floor mounted air-handling units on 6 in. high reinforced concrete pad, 6 in. larger on each side than unit base.

E. Mounting: Mount air-handling units on vibration isolators, in accordance with manufacturer's instructions.

F. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

G. Piping Connections: Refer to Division 23 HVAC sections. Provide piping, valves, accessories, gauges, supports, and flexible connectors as indicated.

H. Duct Connections: Refer to Division 23 Air Distribution sections. Provide ductwork, accessories, and flexible connections as indicated.

I. Filters: Install filters prior to operation of air handling units during construction. Maintain filters during construction to prevent units from becoming dirty. Do not operate units at any time without filters installed.

J. Grounding: Provide positive equipment ground for air handling unit components.

K. VPD's located on same side of unit as coil connections.

L. No piano hinges allowed for doors. Heavy duty butt hinges, minimum 2 for 18" door and less, 3 for more than 18" door.

M. Hangers will be Ventlok 3/0 or equivalent, no plastic door handles.

N. Dampers – Temtrol TD-6, Ruskin CD-50 or approved equal. Provide Class 1 rater, ultra low leak dampers (less than 3 cfm/sq ft. @ 1 w.g.) as indicated on the unit drawings. Low leakage dampers shall have extruded aluminum airfoil blades. Flat or formed metal blades are not acceptable. The dampers blade shall incorporate santoprene rubber edge seals and zinc plated or stainless steel tubular steel shaft for a non-slip operation. Shaft bearings shall

be spherical – non corrosive nylon to eliminate friction and any metal to metal contact. Dampers jamb seals shall be UV rated, nylon glass reinforced or stainless steel spring arcs designed for minimum air leakage and smooth operation. Damper leakage shall be concealed within a 16 gauge galvanized streel frame. Operator furnished and installed by section 23 09 23.

O. Unit Convenience Features
   1. Each section shall be equipped with a vapor-proof 100 watt service light with guard.
   2. Each light shall have its own light switch mounted adjacent to the access door.
   3. Furnish a 120 volt GFI duplex convenience outlet on the exterior of the unit.
   4. Lights, switches and outlets shall be wired from a single point power connection provided with the unit.
   5. Unit shall have a single point power connection for the variable frequency drive.

3.03 FIELD QUALITY CONTROL

A. Testing: Upon completion of installation of air handling units, start-up and operate equipment to demonstrate capability and compliance with requirements. Field correct malfunctioning units, then retest to demonstrate compliance.

3.04 EXTRA STOCK

A. Provide one complete extra set of filters for each air-handling unit. Install new filters at completion of air handling system work, and prior to testing, adjusting, and balancing work. Obtain receipt from Owner that new filters have been installed.

B. Provide one spare set of belts for each belt driven air-handling unit, obtain receipt from Owner that belts have been received.

END OF SECTION 23 73 13

SECTION 23 81 13.17 - TERMINAL UNITS - ELECTRIC

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes electric terminal units as indicated on the Drawings, in schedules, and by requirements of this section.

B. Types of terminal units specified in this section include the following:
   1. Propeller unit heaters.

C. Related Sections:
   1. Section 23 05 12 - MECHANICAL AND ELECTRICAL COORDINATION.
   2. Section 23 41 00 - AIR CLEANING.
   3. Section 23 31 13 - METAL DUCTWORK
   4. Section 23 09 33 - ELECTRIC CONTROL SYSTEMS for automatic controls, not
   5. Section 23 09 93 - SEQUENCE OF OPERATION.
   6. Section 23 05 93 - MECHANICAL TESTING, ADJUSTING AND BALANCING.

D. Electrical Work: Provide the following wiring as work of this section, in accordance with the requirements of Division 26:
   1. Provide control wiring between unit-mounted control panel and thermostats, remote control panels, and any other control device furnished as work of this section.
   2. Provide factory-mounted and wired controls and electrical devices as specified in this section.
   3. Refer to Division 26 sections for other electrical work, including motor starters, disconnects, wires/cables, raceways, interlock wiring, and other required electrical devices which are not work of this section.

1.02 SUBMITTALS

A. General: Do not use submittals as a proposal for equipment that has not been pre-approved during the bid process. Do not base bids on un-approved items!

B. Product Data:
   1. Submit manufacturer's technical product data, indicating full compliance with scheduled capacities and characteristics, including specific capacities at the scheduled entering air conditions.
   2. Include dimensions, weights, operating clearances and specific references to all specialties and accessories as scheduled or specified, including installation and start-up instructions.
   3. Samples: Submit samples of each type of cabinet finish that is furnished on the project.
   4. Data that does not apply to this specific project shall be marked out, or suitably deleted.
   5. 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 apply only to this specific project.

D. Operation and Maintenance Data: Include maintenance data and parts lists for each terminal 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.

1.03 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in the manufacture of hydropic terminal 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. All equipment and descriptive literature shall bear the seal of the particular standard as listed.
   2. NEC Compliance: Comply with applicable requirements of the National Electric Code (1999), including Article 424, pertaining to construction and installation of electrical space heating equipment and appliances.
   3. UL Compliance:
      a. UL Standard 486A: "Wire Connectors and Soldering Lugs for Use with Copper Conductors."
      b. UL Standard 1042: "Electric Baseboard Heating Equipment."
   4. ASHRAE Compliance: Comply with ASHRAE requirements pertaining to application and installation of electric heating terminals.
   5. IEEE Compliance: Comply with applicable provisions of IEEE Standard 241: "Recommended Practice for Electric Power Systems in Commercial Buildings" pertaining to electric heating terminals.
   6. SMACNA Compliance: Comply with applicable provisions of SMACNA Standard, 1985 edition "Ducted Electric Heat Guide for Air handling Systems" which pertains to electric heating terminals.
   7. NFPA Compliance: Comply with applicable provisions of latest edition of NFPA 90A and NFPA 90B pertaining to construction and installation of duct heating units.

1.04 DELIVERY, STORAGE AND HANDLING

A. Handle terminal units and components carefully to prevent damage. Do not install damaged equipment or components. Replace damaged equipment or components with new items.

B. Store equipment and components in a clean, dry place, off the ground, and protect from weather, water, and physical damage.

C. Install equipment and components to comply with the manufacturer's written installation instructions for unloading such equipment, moving it to the proper location and making the final installation.

1.05 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

2.01 PROPELLER UNIT HEATERS

A. Materials and Equipment: Except as otherwise indicated, provide manufacturer's standard electric propeller unit heater materials and components as indicated by published product

information, designed and constructed as recommended by manufacturer, and as required for complete installation.

B. Heating Elements: Except as otherwise indicated, provide manufacturer's standard elements of indicated duty and rated for indicated capacity, consisting of resistance elements in steel sheath with extended fins, or in spiral sheath.

C. Electric Heating Capacity: Size element for indicated fan speed, CFM, room heating load (BTUH), entering air temperature, and electric input (Watts, Voltage, Phase).

D. Casings: Provide casings braced and reinforced to provide required stiffness, and containing heating element supports. Provide rounded corners. Phosphatize and paint casings inside and out with single coat of baked-on enamel; zinc plate hardware. Include fan orifice (venturi) in casing, as well as threaded hanger connections (weld nuts). Fabricate from 18-gage steel.

E. Air Deflectors: Provide manufacturer's standard air deflectors of the following types:
   1. Louver outlets.

F. Motors:
   1. General: Provide totally enclosed shaded-pole, or permanent-split capacitor motors, class "B" insulation, resiliently mounted, tap wound with built-in thermal overload protection, sleeve bearings, or permanently lubricated ball bearings. Electrical characteristics: 120-volt, 60 Hz, single phase.
   2. Motor Controls: Provide remote, wall mounted, and multi-speed motor control switch with "OFF" position.

G. Internal Wiring: Provide high temperature, heat-resistant wiring enclosed in flexible metal conduit extending from terminal junction box to electrical devices. Provide fuses in motor and control circuit wiring.

H. Devices: Provide the following devices:
   1. Thermally activated fan switch to keep fan motor operating until residual heat is dissipated.
   2. Disconnect switch.
   3. Automatic reset, high limit cut-out switch located in discharge air stream.
   4. Magnetic contactor.
   5. Transformer.
   6. Manual "Summer-OFF-Winter" switch.
   7. Wall-mounted thermostat.

I. Fans: Provide aluminum propeller fans, balanced statically and dynamically of indicated capacity. Provide fans suitable for standard or spark proof application.

J. Vibration Insulation: Refer to Division 23 sections.

K. Manufacturers: Subject to compliance with requirements, manufacturers include the following or approved equal:
   1. Reznor
   2. Chromalox Div, Emerson Electric Co.
   3. Markel Nutone Div; Scoville Inc.

PART 3 - EXECUTION

3.01 INSTALLATION OF HEATING TERMINALS

A. Install heating terminal units as indicated, in accordance with equipment manufacturer's written instructions, and with recognized industry practices; complying with applicable installation requirements of NEC and NECA's "Standard of Installation".

B. Coordinate with other electrical work, including wiring/cabling work, as necessary to properly interface installation of heating terminal units with other work.

C. Clean dust and debris from each heating terminal as it is installed to ensure cleanliness.

D. Comb out damaged fins where bent or crushed before covering elements with enclosures.

E. Touch-up scratched or marred heating terminal enclosure surfaces to match original finishes.

F. 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 Std 486A.

3.02 GROUNDING

A. Provide equipment-grounding connections as indicated. Tighten connections to comply with tightening torque values specified in UL STD 486A to assure permanent and effective grounds.

3.03 TESTING

A. Upon completion of installation of heating terminals and after building circuitry has been energized, test heating terminals to demonstrate capability and compliance with requirements. Where possible, field correct malfunctioning units, then retest to demonstrate compliance.

END OF SECTION 23 81 13.17

SECTION 23 89 65 - MOTOR CONTROLLERS

PART 1 - GENERAL

1.01 SUMMARY

A. Manufacturer's Data: Submit manufacturer's data and installation instructions on motor controllers.

1.02 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

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide variable speed (frequency) drives of one of the following:
   1. ABB.
   2. Yaskawa.

2.02 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. 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 40°C. 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

3.01 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.

3.02 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.

3.03 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.

3.04 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.

3.05 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.

3.06 ADJUSTING AND CLEANING

A. Adjust operating mechanisms, where necessary, for free mechanical movement.

3.07 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 23 89 65

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 01 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 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.

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.
   1. Association of Edison Illuminating Companies (AEIC)
   2. American National Standards Institute (ANSI)
   3. Institute of Electrical and Electronics Engineers (IEEE)
   4. Insulated Cable Engineers Association (ICEA)
   5. National Electrical Code (NEC)
   6. National Electrical Manufacturers Association (NEMA)
   7. Electrical Safety in the Workplace
   8. National Fire Protection Association (NFPA)
   9. Underwriter's Laboratories (UL)
   10. IECC 2015
   11. University of Texas at Arlington Standards

B. Work, materials and equipment must comply with the latest rules and regulations of the following.
   1. National Electrical Code (NEC)
   2. Electrical Safety in the Workplace
   3. Occupational Safety and Health Act (OSHA)
   4. American with Disability Act (ADA)
   5. American Society for Testing and Materials (ASTM)
   6. Applicable state and federal codes, ordinances and regulations
   7. University of Texas at Arlington Standards

C. 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 shown.

1.06 SUBMITTALS

A. Submit the following in addition to and in accordance with the requirements of Division 01 for submittal requirement.
   1. 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.
   2. All schematic, connection and/or interconnection diagrams in accordance with the latest edition of NEMA.
   3. 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, and all exposed conduits regardless of size on these drawings. These layout drawings shall be included with all electrical switchgear submittals.

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, 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 over 600 volts, 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.

D. Provide non-metallic material in corrosive areas or as otherwise specified.

PART 3 - EXECUTION

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 all functioning portions of process or buildings during the hours of normal use. 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 two 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 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 equipment passes through walls, ceilings, and floors. Seals shall be watertight and/or fire rated as applicable.

3.05 CONSTRUCTION REVIEW

A. The Engineer or Owner's representative will review and observe installation work to insure 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 26 00 00

SECTION 26 00 00.01 - ELECTRICAL DEMOLITION

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 WORK INCLUDED

A. Electrical demolition for remodeling.

B. Electrical/control portion of HVAC work covered by Division 23 pertaining to electrical demolition shall follow the requirement set forth by this specification.

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 minor electrical demolition for remodeling.
   1. Section 26 00 00 - Basic Electrical Requirements.

B. In the event of conflict regarding minor electrical demolition requirements between this Section and any other Section, the provisions of this Section shall govern.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: as specified in individual Sections.

B. Provide all materials necessary for work.

PART 3 - EXECUTION

3.01 EXAMINATION

A. All demolitions or modifications to existing systems shall be coordinated through Owner's Representative. Demolition drawings are based on casual field observation and existing record documentations. Therefore the accuracy or exactness of the drawings is not guaranteed. The Contractor shall verify that field measurements and circuiting arrangements are as shown on Drawings and abandoned wiring and equipment serve only abandoned facilities. The Contractor shall be responsible for reporting discrepancies to Engineer before disturbing existing installation.

B. Beginning of demolition means Contractor accepts existing conditions.

3.02 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal. Provide temporary wiring and connections to maintain remaining systems in service during demolition and/or modification. Owner reserve the right up to 24 hours prior to any scheduled event to delay or suspend shutdowns or outages to more convenient times at no additional cost.

B. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. No work shall begin without proper permits and authorizations. Disable system only to make switchovers and connections. Obtain permission from Owner at least (2) weeks before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

C. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Notify Owner at least (2) weeks before partially or completely disabling system. Minimize outage duration. Provisions for manual fire watch shall be provided in areas where services are interrupted. Make temporary connections to maintain service in areas adjacent to work area.

D. Existing Telephone System: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Notify Owner at least (2) weeks before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Remove, relocate, and extend existing installations to accommodate new plan drawings.

B. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes full length from source to device. Cut embedded or concealed conduit flush with walls and floors, and patch surfaces.

C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

D. Disconnect and remove abandoned panelboards and distribution equipment.

E. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

F. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

G. Repair adjacent construction and finishes damaged during demolition and extension work.

H. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

I. Extend existing installations using materials and methods compatible with existing electrical installation or as specified.

J. The level of completion shall be demonstrated to Owner’s Representative.

K. Where equipment is indicated to be demolished and returned to Owner, the Contractor shall include the delivery of this equipment to the Owner's site storage area. Remove with care all equipment to be relocated. Repair or replace of newly damaged equipment is the responsibility of the Contractor.

3.04 CLEANING AND REPAIR

A. The Contractor shall follow Owner’s clean work policy and shall include the removal of trash and demolished material from the building or work area at the end of the each day and removal from the site once a week.

B. The Contractor shall be responsible for repairing adjacent construction and finishes damaged during demolition and/or modification. The Contractor shall be responsible for the removal of ceiling tiles required in the demolition work. The Contractor shall be responsible for the replacement of damaged tiles and reinstallation of the ceiling prior to final acceptance.

C. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

D. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts, and broken electrical parts.

3.05 DISPOSITION OF MATERIAL AND EQUIPMENT

A. Review with the Owner materials that have been removed and are no longer required, to determine any which the Owner may desire to keep. Deliver those materials that the Owner desires to the Owner's specified location.

B. For those materials not required by the Owner, dispose of them in accordance with applicable regulations.

END OF SECTION 26 00 00.01

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 01 Specification Sections, apply to this Section.

1.02 WORK INCLUDED

A. Hinged cover enclosures and cabinets.

B. Control relays.

C. Push buttons, and selector switches.

D. Terminal blocks and accessories.

E. Penetration sealing systems (fire stops).

F. 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, 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 26 00 00, 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 16050-1. Exceptions shall be 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, (polycarbonate or fiberglass reinforced polyester (FRP) in corrosive areas).

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 required, 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. Serve from nearest 120V panel from dedicated 1P-20A breaker and circuit.

2.02 CONTROL RELAYS

A. Acceptable Manufacturers
1. General Electric Type CR120A
2. Cutler-Hammer Type M-300
3. Square D Company
4. Allen-Bradley
5. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in 26 00 00 and Division 01 for substitution requirement.

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, provide magnetic control relays with mechanical latch attachment with unlatching coil and coil clearing contacts.

2.03 PUSH BUTTONS, AND SELECTOR SWITCHES

A. Acceptable Manufacturers
1. Allen-Bradley
2. Square D
3. Cutler Hammer
4. Siemens
5. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in 26 00 00 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 as indicated on the Drawings.

E. For corrosive locations, provide nonmetallic components and enclosures meeting NEMA Type 4X.

F. 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 16195.

G. 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.

2.04 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 23 00 00 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 26 00 00 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.

2.05 PENETRATION SEALING SYSTEMS (FIRE STOPS)

A. Provide penetration sealing where conduit, cable tray, etc. pass through rated walls, ceilings, and floors. See Section 07840, Fire Stopping, and Section 07900, Joint Sealants, for sealing requirements and systems.

2.06 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 26 05 00

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 01 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 motors
   2. To electric heaters
   3. To motor starters
   4. From motor starters to motors
   5. To HVAC control and other control devices
   6. 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, Civil, Landscape, Fire Alarm, 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. DOOR OPERATORS: It is the Contractor's responsibility to obtain the submittal data for door operator 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. 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 26 05 18

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 01 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. Outdoor 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. NETA – 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 additional to Section 26 00 00, Basic Electrical Requirements, and Division 01 for submittal requirement.

B. Submit manufacturer's literature and specification data sheets for each item of cable, wire 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.

C. Minimum size for control shall be #14 copper.

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 26 05 53, 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-2. Use XHHW-2 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-2.

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. Life Safety Systems Cable
1. All life safety system wiring shall be installed in dedicated conduit or raceway with adequate separation/shielding from all other systems.
2. Life safety systems wiring shall be as specified in the Section 28 31 00 - Fire Alarm and Smoke Detection Systems.

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: Insulated.
3. Material: Copper (for CU to CU connection).
4. Style:
a. Pigtail connector.
b. Pre-insulated multi-tap connector.
c. 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. Cables 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 underground in raceways, use Type XHHW. Conductors subject to abrasion, such as in lighting poles, shall be Type THWN or THHN.

D. 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. No conductor smaller than #12 AWG shall be used.
   2. Homerun conductors shall be minimum #10 AWG.
   3. 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.

E. Separate neutral conductors shall be provided for each individual circuit of the same size for all 120V single-phase applications. Multiwire branch circuits with a common neutral are not permitted.

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. Install exposed wire and cable, parallel and perpendicular to surface or exposed structural members and follow the surface contours, where possible. This is only permitted in electrical rooms for grounding electrode conductors.

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 wire-ways 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 band 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.

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 grounding conductor. Conduit, wireways, or boxes shall not be used as the equipment grounding conductor.

3.04 CABLE INSTALLATION

A. Provide protection for cables where subject to damage during construction. Do not install cable before the completion of raceway system.

B. Cable above ceilings shall be in conduit or raceways. 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. Multi-Conductor Cable Installation: Do not route 600V cables (power cable and 120V control cable) in the same conduit as low voltage cables (less than 50V, communications, security systems, or control conductors). Do not route security systems, or control cables through communications rooms. Fire alarm cable shall be routed in a separate conduit only.

H. Instrument Cable: Instrument cable shall, when conduit installation is required be installed in rigid steel 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 as indicated on the Drawings.

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. Splices below grade shall

only be in handholes or manholes and shall be made watertight with epoxy resin type splicing kits similar to Scotchcast.

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.

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. Use split bolt connectors for copper wire splices and taps, 6 AWG and larger. Tape un-insulated conductors and connectors with electrical tape to 150 percent of the insulation value of conductor.

H. 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.

I. Identify conductors per Section 26 05 53 - Electrical Identification.

3.06 FIELD QUALITY CONTROL

A. Torque test conductor connections and terminations to manufacturers 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. Lighting fixtures shall not be used for raceways for circuits other than parallel wiring of fixtures.

D. Conductors may be run in parallel on sizes 1/0 to 600 kcmil inclusive provided all paralleled conductors are the same size, length, and type of insulation. Except as otherwise shown on drawings, no more than three conductors may be run in parallel, and they shall be so arranged and terminated as to insure equal division of the total current between all conductors involved. Where parallel connection is contemplated, approval of the Owner's representative must be obtained before installation is made.

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 26 05 19

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 01 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.

D. Lightning protection system 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. Refer to grounding riser diagram, floor plans and drawing details.

B. Provide a completely grounded system in accordance with Article 250 of the NEC.

C. Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, auxiliary gutters, boxes, cable armor, cable sheath, metal frame of the building or structure, ground ring, lightning down lead conductor, grounding conductor in raceways and cables, receptacle ground connectors, and metal underground water pipe.

D. 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.

1.05 SUBMITTALS

A. Provide submittals in accordance with and in additional to Section 26 00 00, 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.

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. Install fusion welded ground connectors where they are concealed or inaccessible.

E. 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.

F. 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.

G. Conductor connections shall be made by means of solderless connectors such as serrated bolted clamps or split bolt and nut type connectors.

3.02 FIELD QUALITY CONTROL

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

END OF SECTION 26 05 26

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 01 Specification Sections, apply to this Section.

1.02 WORK INCLUDED

A. Raceway, cable tray, 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 and cable tray 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 additional to Section 26 00 00, Basic Electrical Requirements, and Division 01for submittal requirement.

PART 2 - PRODUCTS

2.01 MATERIAL

A. Support Channel:
   1. All non-corrosive locations: Hot-dip galvanized steel.
   2. Corrosive locations: Nonmetallic fiberglass.

B. Hardware:
   1. All non-corrosive locations: Hot-dip galvanized steel.
   2. Corrosive locations: Stainless steel threaded rod, attachments and fasteners shall be used with fiberglass supports.

C. Threaded Rod: used for rack support from structure above; 3/8-inch minimum diameter.

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, and cable tray supports. Provide cable tray supports for cable tray filled to 125 percent capacity per NEC.

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. Use fiberglass for nonmetallic raceway systems supports in areas subject to corrosives.

K. All supports in contact with floor using stanchion type support shall be solidly bolted to the permanent structural floor.

L. 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.

M. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.

N. Install freestanding electrical equipment on 4-inch concrete pads. Pad shall be a minimum four inches larger than equipment. No crevices shall be left around the pads.

O. 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 26 05 29

SECTION 26 05 33 - RACEWAY, 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 01 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. NEMA RN 1 – Polyvinyl Chloride (PVC) Externally Coated galvanized Rigid Steel Conduit and Intermediate Metal Conduit

O. UL 6 – Rigid Metal Conduit

P. ANSI/UL 5C – Surface Raceways and Fittings for Use with Data, Signal, and Control Circuits

Q. ANSI/UL 498 – Attachment Plugs and Receptacles

R. ANSI/UL 943 – Ground Fault Circuit Interrupters

1.04 SUBMITTALS

A. Provide submittals in accordance with and in additional to Section 26 00 00, Basic Electrical Requirements, and Section 01 330, Submittal Procedures.

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. Contractor shall compile layout of all penetrations (cast-in sleeves & cores) of all trades and submit to Architect/Engineer for review prior to each concrete floor pour.

E. Submit shop drawing showing all conduits 2" and larger, and all exposed conduits regardless of size.

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 only permitted where shown on drawings.

B. Wireways shall be of steel construction general purpose for indoor spaces. Wireways not permitted outdoors.

C. Size shall be as indicated on Drawings.

D. Cover shall be hinged.

E. Fittings shall be so constructed to continue the "lay-in" feature through the entire installation.

F. 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. Electrical power and lighting feeders
   2. Electrical power and lighting circuits
   3. IT systems
   4. Control systems (other than HVAC)
   5. Fire alarm and signaling systems
   6. Security systems
   7. Audiovisual systems
   8. 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. All conduit terminations shall be equipped with plastic bushings or insulated throats. This includes terminations at panels, switchgear, disconnects, pull boxes, outlet boxes, etc.

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 type. Expansion fittings shall be OZ Type TX. Set-screw type are not acceptable.

F. Flexible metal conduit and fittings shall be zinc-coated steel.

G. 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.

H. 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.

I. Fittings shall be steel. Malleable metal fittings are not acceptable.

J. Crimp or set-screw type fittings are not acceptable.

K. Minimum conduit size shall be 3/4 inch, except 1/2 inch flexible metallic conduit may be used as fixture whips. The use of MC is also permitted for fixture whips. Flexible metallic conduit and MC shall not be used for exposed fixture whips.

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 2-1/8" deep unless shallower boxes are required by structural conditions and are approved by the A/E.

B. Provide extension rings as required to bring flush with surface.

C. Provide deep type cast metal weatherproof exterior outlet wiring boxes of the type, shape and size, including depth of box, with threaded conduit ends, cast metal face plate with spring-hinged waterproof cap suitably configured for each application, including face plate gasket and fasteners.

D. Outlet boxes in poured concrete shall be plenum type without any holes and with reset knockouts. Where extension rings are used to offset conduit between wall reinforcing steel, joint between extension ring and box shall be sealed to prevent concrete from entering box during pour.

E. Provide 4-inch square ceiling outlet boxes.

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 12 inches in any dimension shall be panelboard code gauze galvanized steel with hinged cover.

C. Boxes shall be sized in accordance with NEC.

D. Provide cast-in-place, pre-cast concrete or die-molded fiberglass handholes/pull boxes as per design for underground installations. Cast-in-place and pre-cast boxes shall be provided with reinforcing bars with material compressive strength no less than 11,000 psi, and shall be approved by Owner/Structural Engineer.

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. Install rigid wall hot-dipped galvanized steel conduit or hot-dipped galvanized intermediate metal conduit. The following exceptions permitted:
   1. EMT
      a. May only be used inside dry air-conditioned locations where installed above ceilings or concealed in walls.
   2. Underground Use Only
      a. Install PVC schedule 40 conduit.
   3. Liquid-tight
      a. Install liquid-tight flexible metal conduit for connections to rotating, vibrating, moving or movable equipment, including motors and HVAC equipment. Maximum length shall be 6 feet minimum of 2 feet. Minimum size ¾ inch.
   4. Flexible Metal Conduit
      a. Install standard flexible metal conduit (not liquid-tight), which shall be only used for lighting fixture whips for lay-in fixtures. Maximum length shall be 6 feet minimum of 4 feet.

D. 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. Wire ties, and spring clips are specifically not permitted. Do not support from ceiling support wires. Arrange conduit to maintain headroom and present a neat appearance. Conduit routes shall follow the contour of the surface it is routed on. Route conduit and tray parallel and

perpendicular to building lines, and parallel to walls and adjacent piping. Maintain 12-inch clearance between conduit and heat sources, such as flues, steam pipes, and heating appliances. 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.

E. Install conduits outside of building lines at a minimum depth of 30 inches below finished grade. Maintain twelve inches earth or two inches concrete separation between electrical conduits and other services or utilities underground.

F. 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.

G. Fittings shall be approved for grounding purposes or shall be jumpered with a copper grounding conductor of appropriate ampacity. Leave termination of such jumpers exposed.

H. Install expansion fittings in metal and PVC conduit as follows:

1. Conduit Crossing Building Expansion Joints:
2. EMT all sizes
3. IMC all sizes
4. RMC all sizes
5. PVC all sizes
6. Conduits entering environmental rooms and other locations subject to thermal expansion and as required by NEC.
7. 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 this green grounding conductor shall be accessible for inspection.

I. Install conduit concealed in walls, partitions, above ceilings and below floors. Install conduit exposed in ceiling area (at structure) of electrical and mechanical rooms.

1. Install conduit concealed in slab when finished areas below do not have ceiling. A written approval shall be obtained from Owner/Structural Engineer prior to construction.

J. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.

K. 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.

L. Provide 200 lb. nylon cord full length in empty conduit.

M. 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.

N. 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.

O. Conduit entering / exiting cable tray shall be attached to the tray rail by means of strut bolted to the rail and standard manufacturer's accessories or by use of a UL listed conduit to tray connector. Conduit shall only enter / exit tray horizontally supported within 3 feet of the tray and extend into the tray 2 inches. Conduit shall be terminated with a grounding bushing and bonded to the ground conductor routed in the tray. (The attachment to the tray shall not be considered a ground.)

P. Pull string shall be provided full length in conduit designated for future use.

3.02 INSTALLATION - WIREWAYS

A. Bolt wireways to steel channels fastened to the wall or in self-supporting structure. Install level.

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, even if dimensioned.

D. Locate and install boxes to allow access. In areas with ceilings, boxes shall be installed no less than 12” and no more than 36” above ceiling. Obtain approval for each instance where requirement cannot be accommodated.

E. 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.

F. 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. Boxes connected to one stud are not permitted.

G. Provide knockout plugs for unused openings.

H. 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.

I. Install boxes in walls without damaging wall insulation.

J. 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.

K. Outlet boxes for switch shall not be used as junction boxes.

L. Coordinate mounting heights and locations of outlets mounted above counters, benches and backsplashes.

M. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaire, to be accessible through luminaire ceiling opening.

N. 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 in writing by the Structural Engineer prior to execution. 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 26 05 33

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 01 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 additional to Section 26 00 00, 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.
   4. Nameplates shall have panel designation, voltage, phasing, panel designation feeding panel, and location of panel feeding.

EXAMPLE

PANEL LA
208/120V 3PH 4W
FED FROM PNL DPE
LOC: ROOM 100

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. Tape Labels: Embossed adhesive tape, with minimum 1/4-inch letters for labeling receptacles, lighting control stations, control device stations, junction boxes, pull boxes, manual motor starter units, etc.
   1. Black letters on white background for normal power.
   2. White letters on red background for emergency/standby power.
   3. Refer to 26 27 26 Wiring Devices for labeling of devices in public spaces. Do not use tape labels in public spaces.

F. J-Box and Cover plate Voltage Labels: Black stenciled letters 1/4" high. Adhesive back tapes may be used if a clear tape is applied over the label for protection.

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. All conductors for power circuits of all sizes shall have factory applied color coding consisting of colored jacket. Color code shall match existing facility if different than below.

	SYSTEM VOLTAGE			
Conductor	480/277V	208/120V	240/120V High Leg	Medium Voltage
Phase A	N/A	Black	N/A	N/A
Phase B	N/A	Red	N/A	N/A
Phase C	N/A	Blue	N/A	N/A
Neutral	N/A	White	N/A	N/A
Grounding IG	N/A N/A	Green Green w/Yellow	N/A N/A	N/A N/A

C. Conductors serving occupancy sensor controlled receptacles shall be color as indicated above except with colored stripe.

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 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 BOX AND ENCLOSURE COLOR CODING

A. The following systems shall have conduit, junction box/cover, and pull box/cover completely painted per the following:

SYSTEM	COLOR OF BOX COVER
Ethernet Backbone	Blue
Telecommunications	Brown
FCMS	Green
Emergency Power	Red
Security**	White
Fire Alarm	Yellow

**Security shall include, but not be limited to, the following systems:

- Card Access
- Duress Alarms
- Perimeter Door Alarms
- CCTV

END OF SECTION 26 05 53

SECTION 26 05 73 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

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 computer-based, fault-current and overcurrent protective device coordination studies and arc-flash study. Protective devices shall be set based on results of the protective device coordination study.
   1. Coordination of series-rated devices is not permitted.

1.03 SUBMITTALS

A. Preliminary coordination study based on contractor furnished estimated conductor lengths shall accompany switchgear submittal.

B. Final study based on contractor furnished actual conductor lengths.

1.04 QUALITY ASSURANCE

A. Study shall be conducted by electrical switchgear manufacturer supplying equipment on project.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.01 POWER SYSTEM DATA

A. Gather and tabulate the following input data to support coordination study:
   1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
   2. Electrical Distribution System Diagram.
   3. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram.

3.02 FAULT-CURRENT STUDY

A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
   1. Existing service entrance transformer.
   2. Existing main switchboard.
   3. Distribution panelboard.

4. Branch circuit panelboards.

B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

C. Calculate momentary and interrupting duties on the basis of maximum available fault current.

D. Study Report:
   1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.

E. Equipment Evaluation Report:
   1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
   2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
   3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

F. 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.

G. Series rating is not permitted.

3.03 COORDINATION STUDY

A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
   1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
   2. Calculate the maximum and minimum ground-fault currents.

B. Transformer Primary Overcurrent Protective Devices:
   1. Device shall not operate in response to the following:
      a. Inrush current when first energized.
      b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
      c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
   2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

C. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

D. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
   1. Tabular format of settings selected for overcurrent protective devices:

2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices.

E. Completed data sheets for setting of overcurrent protective devices.

F. Contractor shall adjust all devices in accordance with recommended and approved settings.

3.04 ARC-FLASH STUDY

A. Provide arc-flash study and label equipment with required personal protective equipment (PPE).

END OF SECTION 26 05 73

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following lighting control devices:
   1. Time switches.
   2. Outdoor photoelectric switches.
   3. Power packs
   4. Low voltage lighting control stations
   5. Daylight sensors
   6. Lighting relays.
   7. Lighting contactors.
   8. Integration with existing Fresco lighting control panel and nLight communication network.

1.03 DEFINITIONS

A. PIR: Passive infrared.

1.04 SUBMITTALS

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

B. Shop Drawings: Show installation details for vacancy, occupancy and light-level sensors.
   1. Interconnection diagrams showing field-installed wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.06 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire alarm system, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.01 TIME SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Intermatic, Inc.
   2. Paragon Electric Co.; Invensys Climate Controls.

3. TORK.

B. Electronic Time Switches:
   1. Digital type
   2. Contact Configuration: As required or specified.
   3. Contact Rating: 30-A inductive or resistive, 240-V ac, 20-A ballast load, 120/240-V ac.
   4. Programs: Four channel, 24 hour
   5. Battery backup

2.02 OUTDOOR PHOTOELECTRIC SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Intermatic, Inc.
   2. Paragon Electric Co.; Invensys Climate Controls.
   3. TORK.

B. Description: Solid state, with dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.
   1. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
   2. Time Delay: 15-second minimum, to prevent false operation.
   3. Surge Protection: Metal-oxide varistor, complying with IEEE C62.41.1, IEEE C62.41.2, and IEEE 62.45 for Category A1 locations.
   4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

2.03 DAYLIGHTING SENSORS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Lithonia Lighting; Acuity Lighting Group, Inc.

B. Automatic Light-Level Sensor (for areas with daylighting sensor): Adjustable from 2 to 200 fc; dim lighting or turn lighting off when selected lighting level is present.

C. Equal to Lithonia, Acuity Lighting Group.

2.04 LOW VOLTAGE LIGHTING CONTROL STATIONS AND ROOM CONTROLLERS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Lithonia Lighting; Acuity Lighting Group, Inc.

B. Wall mounted lighting control stations shall be low voltage type by same manufacturer as vacancy sensors and shall be equipped with number of buttons to provide specified function and control.
   1. Submit wall station configurations for approval.
   2. Submit engraved pushbutton naming for approval.

C. Room controllers shall be by same manufacturer as occupancy/vacancy sensors.
   1. Locate room controller above accessible ceiling adjacent to doorway of room being controlled in a location accessible by ladder.
   2. Mount controller to side of J-box (do not locate inside J-box).

2.05 LIGHTING CONTACTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Allen-Bradley/Rockwell Automation.
   2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
   3. GE Industrial Systems; Total Lighting Control.
   4. Square D; Schneider Electric.

B. Description: Electrically operated and mechanically held, combination type with nonfused disconnect, complying with NEMA ICS 2 and UL 508.
   1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
   2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
   3. Enclosure: Comply with NEMA 250.
   4. Provide with control and pilot devices as required, matching the NEMA type specified for the enclosure.
   5. Minimum contactor rating of 30 amps.

C. Provide auxiliary relays as required.

PART 3 - EXECUTION

3.01 LIGHT LEVEL AND DAYLIGHT SENSOR INSTALLATION

A. Install and aim sensors in locations as recommended by manufacturer. System shall provide full range dimming to take advantage of available daylight contribution.

B. Upon completion of the installation, the system shall be completely commissioned by the manufacturer's factory authorized technician who will verify all adjustments and sensor placement to ensure a trouble-free occupancy-based lighting control system.

C. The electrical contractor shall provide both the manufacturer and the electrical engineer with ten working days written notice of the scheduled commissioning date. Upon completion of the system fine-tuning the factory authorized technician shall provide the proper training to the owner's personnel in the adjustment and maintenance of the sensors.

D. Lighting control system manufacturer shall provide site visits, and follow up site visits as required at no additional cost to Owner.

3.02 CONTACTOR INSTALLATION

A. Mount lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.03 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. After installing lighting control devices and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
   2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

B. Lighting control devices that fail tests and inspections are defective work.

3.04 ADJUSTING

A. Daylighting Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions.

END OF SECTION 26 09 23

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 01 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 additional to Section 26 00 00, Basic Electrical Requirements, and Division 01for 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.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver 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. Cutler Hammer

2.02 PANELBOARD CONSTRUCTION

A. General: Provide flush or surface mounted, or surface mounted deadfront circuit breaker type distribution or branch circuit panelboards with electrical ratings and configurations, as indicated on the drawings and schedules. Load center type of panelboards are not acceptable.

B. Enclosure:
   1. Enclosure shall be proper NEMA type as shown on the drawings.
   2. NEMA 1
      a. Back box shall be galvanized steel for flush mounted branch circuit panelboards. Back box shall have gray enamel electro-deposited finish over cleaned phosphatized steel for all other type panelboards.
      b. Provide panelboard fronts with door-in-door construction and flush lock.
   3. NEMA 3R, 3S and 12
      a. Enclosure and doors shall have gray enamel electro-deposited finish over cleaned phosphatized steel.
      b. Doors shall be gasketed and equipped with tumbler type vault lock and two trunk latches where required by UL standard. Interior trim shall consist of four pieces, each covering one gutter top, bottom and both sides.
   4. Construct cabinet in accordance with UL 50. Use not less than 16-guage 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, metering equipment, and where required by code.
   5. Exterior and interior steel surfaces shall be cleaned and finished with gray enamel over rust inhibiting phosphatized coating. Color shall be ANSI 61 gray.
   6. Doors shall be equipped with flush-type combination catch and key lock. All locks shall be keyed alike.
   7. Branch circuit panelboards shall be 5-3/4 inches deep.
   8. A directory holder with heavy plastic plate, metal frame, and index card shall be mounted inside of each door.
   9. Reinforce enclosure and securely support bus bars and overcurrent devices to prevent vibration and breakage in handling.
   10. Rating: Minimum integrated short-circuit rating, voltage and current rating as shown on drawings.
   11. Labeling: The Contractor shall furnish and install engraved, laminated plastic nameplates on the trim per Section 26 05 53, Electrical Identification

C. Bus:
   1. Provide panelboards with rounded edge phase, neutral and ground buses, rated full capacity as scheduled on drawings. Buses shall be full-length copper 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.

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. Provide handle padlock attachments on circuit breakers where indicated on drawings. Device shall be capable of accepting a single padlock. All circuit breakers shall be capable of being individually padlocked in the off position.

D. 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.

E. All circuit breakers shall be provided with visible ON and OFF indications.

F. Provide GFI circuit breakers as indicated on drawing or per NEC requirement.

G. 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.

H. 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.

I. Current Limiting Molded Case Circuit Breakers:
   1. Breakers 100 ampere frame shall be inverse time delay thermal and instantaneous magnetic trip.
   2. Breakers 250 ampere and 400 ampere frame shall be solid-state trip with built-in current transformers, solid-state trip unit and flux transfer shunt trip.
   3. Current limiting breakers shall protect downstream molded case breakers. Submit manufacturer's test data proving the protection, from both peak currents and I2T energy of downstream devices.

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: As per Drawings, but such that highest operating handle is no greater than 79 inches above finished floor.
   2. Branch Circuit Panelboards: As per Drawings, but such that highest operating handle is no greater than 79 inches above finished floor.

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 26 05 53, 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 circuit as shown on Panel Schedule drawings. 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 26 24 16

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 01 Specification Sections, apply to this Section.

1.02 WORK INCLUDED

A. Wiring Devices:
   1. Wall switches.
   2. Receptacles.
   3. Data/telephone.
   4. Device plates and box covers.

1.03 REFERENCES

A. Americans with Disabilities Act (ADA)

B. ANSI/UL 20 – General Use Snap Switches.

C. ANSI/UL 498 – Attachment Plugs and Receptacles.

D. ANSI/UL 943 – Ground Fault Circuit Interrupters.

E. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts maximum).

F. NEMA WD 1 – General-Purpose Wiring Devices.

G. NEMA WD 5 - Specific-Purpose Wiring Devices.

H. Texas Accessibility Standards. (TAS)

1.04 SUBMITTALS

A. Provide submittals in accordance with and in additional to Section 26 00 00, Basic Electrical Requirements, 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 and cover plate color:
   1. Switches, receptacles, and lighting control stations on normal power shall be white unless noted otherwise.
   2. Switches, receptacles, and lighting control stations on emergency power shall be red.

3. Stainless steel cover plates as noted in 2.4, B.
4. Coordinate color of devices and device plates in other areas with the architectural finish. Refer to architectural drawings and specifications.
5. For renovation or expansion of existing facilities, provide devices and plates to match existing (verify prior to submitting device and plates for approval).

2.02 WALL SWITCHES

A. Acceptable manufacturers
   1. P&S

B. Material
   1. 120/277 volt, white, poles as required, extra heavy duty plugtail type, PT20AC1 or PT20AC3 (3 way).

2.03 RECEPTACLES

A. Acceptable manufacturers
   1. P&S

B. Material
   1. Duplex convenience: 20 ampere, 125 volts, white, extra heavy duty plugtail type, PT5362AI.
   2. GFI duplex convenience: 20 ampere, 125 volts, white with test and reset, extra heavy duty plugtail type, PT2095.
   3. Special purpose receptacle: Type, rating, number of poles as required. Provide matching plug and cord where required.

2.04 DATA/TELEPHONE

A. All wiring, boxes, raceways, jacks, etc. shall conform to UTA OIT Campus Network Services Standards of Installation for network cabling.

B. Provide turnkey installation including all components, wiring, terminations and testing.

C. Wiring shall be Category 6 (verify with UTA).

D. All wiring shall terminate in HUB room as determined by UTA.

2.05 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 26 00 00 and Division 01 for substitution requirement.

B. Material
   1. Wall plates in IT, mechanical rooms, electrical rooms, and janitor closets shall be 430 stainless steel with cutouts as required for devices indicated on drawings, unless otherwise noted. Other wall plates shall be unbreakable heavy duty nylon (white, except red for emergency power), 0.1 inch thick. 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.

2. 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
3. Jumbo plates are not permitted.
4. Weatherproof cover plate shall be cast aluminum with hinged gasketed cover, P&S 4500.

C. Telephone/data per UTA Standard.

2.06 LABELING

A. Electrical Identification, on receptacles and switches indicating panelboard and circuit number. White tape with 3/16 inch black letters/numbers. Provide tape labels in accordance with Section 26 05 53.

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.
    3. Where more than one device occurs in one outlet box, causing 300 volts or more voltage difference between them, a barrier must be provided for isolation to meet NEC Article 380.

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 3’-6” above finished floor, OFF position down for switches.
        b. Where wainscot occurs at the 3’-6” level, install device in the wall below the wainscot and as near the 3’-6" 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 switches and lighting control stations not less than 2" and not more than 12" from door trim, unless wall space is not available due to glass.
d. Verify all door swings before rough-in and locate switches and lighting control stations 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, telephone and data 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 all device mounting heights with 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:
3. Install receptacles vertically with ground pole on bottom. Install receptacles horizontally, where field condition does not allow vertical installation, with ground pole on left.
4. All receptacles with 6 feet of a water source such as sinks shall be GFCI type. 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 General 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.

E. Within renovated project area, where existing receptacle locations are being reused, replace existing receptacles to comply with all requirements of this section.

END OF SECTION 26 27 26

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 01 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 additional to Section 26 00 00, Basic Electrical Requirements, and Division 01for submittal requirement.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Store fuses in a clean and dry space and protected from weather. When necessary to store outdoors, elevate materials well above grade and enclose with durable, waterproof wrapping.

PART 2 - PRODUCTS

2.01 MATERIAL AND EQUIPMENT

A. Furnish fuses manufactured by Buss, or equal, in accordance with the following:
   1. Motors and Transformers, 0 to 600 Amp:
      a. 250 volt - Buss LPN-RK, UL Class RK1.
      b. 600 volt - Buss LPS-RK, UL Class RK1.
   2. Lighting Loads, 0 to 600 Amp:
      a. 250 volt - Buss KTN-R, UL Class RK1.
      b. 600 volt - Buss KTS-R, UL Class RK1.
   3. All Applications, 601 to 6000 Amp:
      a. 600 volt - Buss KRP-C, UL Class L.

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. Furnish spare fuse cabinet sized to contain required spare fuse stock.

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 26 28 13

SECTION 26 28 16 - DISCONNECT SWITCHES

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 WORK INCLUDED

A. Disconnect switches, fusible and non-fusible.

B. Enclosures.

1.03 REFERENCES

A. Federal Spec. W-S-865 - Switch, Box (Enclosed), Surface-Mounted.

B. NEMA KS 1 - Enclosed Switches.

C. NFPA 70 - National Electrical Code

D. NFPA 70E - Electrical Safety Requirement for Employee Workplaces

E. UL 98 - Enclosed Switches.

1.04 SUBMITTALS

A. Provide submittals in accordance with and in additional to Section 26 00 00, Basic Electrical Requirements, and Division 01 for submittal requirement.

B. Submit manufacturer's product data. Submit dimensioned drawings and equipment ratings for voltage, capacity, horsepower, and short circuit.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver switches individually wrapped in factory-fabricated water-resistant type containers.

B. Handle switches carefully to avoid damage to material components, enclosure and finish. Damaged switches shall not be installed on project.

C. Store switches in a clean and dry space and protected from weather.

PART 2 - PRODUCTS

2.01 FABRICATED SWITCHES

A. Acceptable Manufacturers:
   1. Square D.
   2. Cutler Hammer

B. NEMA KS 1; Type HD quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Handle lockable in ON position for service entrance disconnect. Provide defeater so that qualified personnel can open door while switch is in the closed position.

C. Use switches that have number of poles required as per drawings.

D. Switches shall be Underwriters' approved for duty shown and enclosure type per drawings. NEMA 3R switches shall be provided where exposed to weather. NEMA 3R switches shall have weatherproof threaded hubs for all conduit entries into switch.

E. Use fuse clips that are rejecting type to accept Class RK or L fuses only.

F. Identify switches, as to equipment served, with engraved laminated plastic plates. Refer to 26 05 53 Electrical Identification Section of this specification.

G. Voltage rating: 240VAC.

PART 3 - EXECUTION

3.01 INSPECTION

A. Installer shall examine the areas and conditions under which safety and disconnect switches 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 SAFETY AND DISCONNECT SWITCHES

A. Install safety or disconnect switches, where required by NEC, where indicated on drawings, and where required by equipment manufacturer, in a location convenient for maintenance on switch and adjacent equipment.

B. For equipment with motors larger than 1/8 hp, install disconnect switches within sight of the motor.

C. Provide fused disconnect switches, whether or not indicated on drawings, when required to maintain equipment manufacturer’s warranty and as required to comply with NEC. Coordinate with Division 23 for warranty requirements of equipment approved by submittal.

D. Install fuses in fusible disconnect switches. Provide permanent marking inside switch enclosure for fuse type.

E. Wall mount switches, where possible, or mount on unistrut supports.

END OF SECTION 26 28 16

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 01 Specification Sections, apply to this Section.

1.02 WORK INCLUDED

A. Complete lightning protection system for the new building. Interconnect with existing building system. Include recertification of existing lightning protection system.

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 26 00 00 - Basic Electrical Requirements
   2. Section 26 05 33 - Raceways, Conduit, and Boxes
   3. Section 26 05 26 - 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 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 26 00 00, 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, floor penetrations, etc., and their compatibility with provisions made during the construction. Once the contract has been established the Contractor shall make a review of provisions being made for the system installation and comment, in writing, with changes or compliance within two weeks of finalizing the contract. Contractor shall coordinate locations of conductors in walls and all penetrations with the appropriate trades: Failure to coordinate these requirements shall not relieve lightning protection Contractor from properly completing its work. This Contractor shall employ the proper trades to provide the chases in walls and roof and floor penetrations required to install the conductors if not coordinated before the floors, walls and roof are installed.
   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 26 00 00.

1.09 MASTER LABEL

A. The system design shall equal to or exceed the requirement of UL 96A for a Master Label. Upon completion, the lightning protection systems shall be inspected by a representative of Underwriters Laboratories, Inc. The lightning protection systems must pass inspection and wear UL Master Label.

1.10 WARRANTY

A. Provide a warranty for material and installation per Section 26 00 00, 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. Provide copper down conductors with bimetal transition at the roof assembly rated for the application.

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 per UL 96. A copper or copper alloy air terminal intended for use on a chimney shall have a hot-dipped lead coating or equivalent. Class II air terminal shall be of solid construction. Air terminal minimum diameter shall be in compliance with NFPA 780.

2.04 GROUND ROD

A. Ground rod shall be copper-clad steel, ¾-inch diameter by 10 feet in length.

2.05 CONNECTIONS

A. Connector fittings shall be copper or copper alloy per UL 96 and compatible with material type used for air terminals and conductors.

B. All belowground and concealed connections shall be made with exothermic welded connections.

2.06 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.

3.03 CONDUCTORS

A. Install in accordance with manufacturer's instructions. Conceal down conductors. Concealed down 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. The Contractor shall bond each down conductor to the ground rod (Cad-Weld or equivalent) which is bonded to the counterpoise conductors creating a common ground.

D. 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 GROUND RING ELECTRODE

A. Rework and extend existing ground ring.

B. Lightning protection systems down conductors shall be connected to the ground ring electrode.

C. Interconnect lightning protection ground ring electrode with building ground electrode system.

3.06 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.

3.07 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.

3.08 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.

3.09 INSPECTION AND MASTER LABEL

A. The lightning protection system shall be provided with a UL Master Label.

B. Obtain the services of UL to provide inspection and certification of the lightning protection systems. If the system does not pass 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.

3.10 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 26 41 00

SECTION 26 51 00 - INTERIOR AND EXTERIOR LIGHTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 WORK INCLUDED

A. Interior lighting fixtures and accessories

B. Exterior lighting fixtures and accessories

C. Exit lights

D. Drivers/Power supplies

E. Site lighting poles

F. Lighting controls

1.03 DESCRIPTION OF WORK

A. Provide luminaires as shown on Contract Drawing and Specifications.

B. Luminaires shall be provided complete with necessary accessories for proper installation.

C. Catalog numbers shown in luminaire schedule are basic luminaire types. Additional features, accessories and options specified or scheduled shall be included.

D. Provide LEDs for luminaires as recommended by luminaire manufacturer and as scheduled.

E. Provide luminaires as a fully operating system including LED modules and power supplies as designed and tested by the manufacturer.

F. Specifications and drawings convey the features and functions of luminaires only and do not show every item or detail necessary for the work.

G. Work includes final aiming and focusing of luminaires under direction of the Architect/Lighting Designer.

1.04 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 LM-79-08 Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products.

F. IES LM-80-08 Approved Method: Testing lumen Maintenance of LED Light Sources

G. IESNA – Lighting Handbook – Latest edition

H. NEMA WD 1 - General Color Requirements for Wiring devices

I. NFPA 70 – National Electrical Code

J. IECC 2015

K. Standards For State-Funded Outdoor Lighting Fixture – Texas House Bill 916 (1999)

1.05 DESIGN CRITERIA

A. Lighting level design shall be per IESNA (Illuminating Engineering Society of North America) recommendation practice – latest revision

B. The power consumption for interior and exterior lighting shall not exceed power allowance as per IECC 2015.

1.06 QUALITY ASSURANCE

A. Luminaire and accessory components shall be constructed of materials appropriate for their use.

B. Luminaires, drivers, LEDs and other components shall meet the requirements of all applicable State and Municipal energy codes.

C. Provide luminaires listed and labeled for their indicated use and installation conditions.

D. Contractor shall coordinate installation of lighting systems with all trades.
   1. Manufacturers listed in the luminaire schedule shall be assumed capable of supplying listed luminaires. Any such exceptions shall immediately be brought to the attention of Architect and Lighting Consultant. Multiple Name Specification:
      a. When multiple manufacturers are listed, Electrical Contractor shall choose which of the listed products are to be provided.
      b. Products of the same type shall be of same manufacturer.
   2. Single Name Specification:
      a. When only one product is suitable for the application and/or no other known acceptable products exist, only one manufacturer/product is listed in the Luminaire Schedule. For such instances, Electrical Contractor shall provide the listed product with no exceptions.
      b. Specifier has secured accurate pricing for all single name products prior to bidding and has shared this information with Architect/Owner's Representative. Contractor shall supply contractor net unit pricing for all single name products specified. Unit price shall be for equipment only and not include installation or miscellaneous electrical costs.
   3. Contractor shall coordinate and verify compatibility of luminaires with lighting control system.
      a. Control protocol indicated for luminaires matches protocol of lighting control system. Contractor shall coordinate and verify compatibility of all dimming luminaires with control system to ensure that dimming is flicker free, continuous dimming through the dimming range noted on the luminaire schedule.

E. Substitution requests:
   1. Will be evaluated prior to Bid.
   2. Shall follow procedures set forth in this Section and in Section 01 2500 - Substitution Procedures.
   3. Shall be made not less than 14 days prior to bid date.
   4. Shall include the following information indicating that the proposed substitution is of similar lumen output and distribution, color temperature, color consistency, 0-10V control, general appearance, and quality:
      a. Specified and proposed manufacturer's product data sheet, noting options and features.
      b. Provide dimensioned drawing of luminaire.
      c. Provide photometric data in form of an electronic IES file on CD, for use in a recognized computer lighting program.
   5. Provide table-top samples and/or mockup of specified luminaire and proposed alternate.

6. Samples shall:
   a. Be fully operable, complete with specified LED(s) and ready for installation.
   b. Remain available during construction.
7. Electrical Contractor shall be responsible for all costs incurred by substitution request sample and/or mockup production and review.
8. Equipment delivery lead time shall not be held as a valid reason for requesting luminaire substitution unless luminaire lead time from specified manufacturer is in excess of 14 weeks. It shall be the sole responsibility of the Electrical Contractor to determine necessary equipment lead times, deliver submittals for review in a timely fashion, and place orders accordingly to ensure timely delivery.
9. When requesting a substitution, Electrical Contractor shall provide unit and extended pricing for specified luminaire, unit and extended pricing for proposed alternate, and unit and extended delta savings to owner to be realized by accepting proposed alternate. If requested, provide unit pricing for each luminaire type specified to provide a baseline comparison for substitution request.
10. Electrical Contractor shall guarantee pricing on all luminaire types for which a substitution request has been granted. This price guarantee shall be per unit and shall be maintained through the end of construction, regardless of quantity purchased.

1.07 SUBMITTALS

A. Provide submittals in accordance with and in additional to Section 26 00 00, Basic Electrical Requirements, and Division 1 for submittal requirement.

B. Submit manufacturer's data on interior and exterior 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. Should Electrical Contractor anticipate that delivery schedule of any specified product may adversely impact construction schedule, it shall bring it to the attention of the Owner when shop drawings are submitted.

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 ration, efficiency and visual comfort probability. Also provide luminaire weights, mounting data, and accessory information for each luminaires type.

D. Detailed drawings of linear and suspended luminaires including dimensions, support spacing, suspension type, power feed type and locations, driver type and locations, luminaire joint locations and end plates.

E. Detailed drawings for each recessed linear wall system configuration including dimensions, power feed locations, driver locations, luminaire joint locations, extension plates for end and corner sections and end plates.

F. LEDs: Catalog cuts showing voltages, color temperature, color consistency, approximate hours life, approximate initial lumens, and lumen maintenance curve.

G. Drivers: Catalog cuts showing type, wiring diagram, nominal watts, input voltage, starting current, input watts, sound rating, power factor and low temperature characteristics.

H. For luminaires being controlled by the lighting control system, submit documentation that indicates specified products have been tested, or will be tested, for compatibility with the system being procured and will perform as specified. Control system shall be able to control luminaires with flicker free, continuous dimming, in range specified. The lighting fixture manufacturer and lighting control manufacturer shall be financially responsible for any incompatibilities.

I. Site lighting pole data and catalog cuts, including wind loading, complete dimensions and finish.

J. Shop drawings for site lighting luminaires showing pertinent physical characteristics, including fastening details, driver type and location.

K. Controls: Catalog cuts and/or shop drawings showing dimensions, voltage capacity, contact ratings, wiring diagrams, operating levels, and temperature ratings.

L. Lighting design shall be in compliance with power allowance for lighting, which is stipulated by IECC 2015. Compliance forms along with engineering data associated with it shall be submitted for Owner's review during design phase.

M. Point-by-point foot-candle analysis for all indoor and outdoor spaces.

1.08 SAMPLES

A. Upon return of submittals, and prior to release for manufacturing, Contractor shall furnish one sample of each luminaire for which sample requirement is noted.

B. Shipping: Samples shall be complete with specified LED(s), cord and plug, ready for hanging, energizing, and examining, and shall be shipped, prepaid by Contractor, to Architect/Engineer, or as otherwise advised.

C. Samples will not be returned, nor included in quantities listed for project.

D. Sample must be actual working unit.

1.09 LUMINAIRE MOCK-UPS

A. Where luminaire mock-up is required, upon return of submittals, and prior to release for manufacturing, Contractor shall provide mock-up on site (or at another agreed upon location) in actual architectural conditions for review by Architect/Lighting Designer and Owner.

B. Provide type and quantity of luminaires as requested by Architect/Lighting Designer.

C. Mock-up shall include working luminaires and fastening devices.

1.10 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, lenses, pendants, drivers/power supplies, poles and wiring.

2.02 INTERIOR LIGHTING FIXTURES

A. Construction

1. Luminaires shall bear label indicating circuit voltage. Labels shall not be visible from normal viewing angles.

2. Luminaires shall be constructed with joints made by means of welded, brazed, screwed, or bolted construction methods.
3. Housings shall be so constructed that all electrical components are accessible and replaceable without removing luminaires from their mountings.
4. Surface temperatures of luminaires with drivers shall not exceed 194°F in 86°F ambient.
5. Miter cuts shall be accurate, joints shall be flush and without burrs.
6. Provide inscription for exit signs to conform to applicable codes.

2.03 LEDS

A. General Construction
1. LED luminaires are an electromechanical system with dependent components that must be evaluated as a complete system and therefore all LED components are grouped together in this section. Each LED luminaire includes a light emitting source, provisions for heat transfer, electrical control, optical control, mechanical support and protection, as well as aesthetic design elements.

B. Luminaires
1. 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.
2. Luminaires shall meet the US Department of Energy's Energy Star performance criteria.
3. Shall have DOE's LED Lighting Facts Labeling or be listed on Design Lights Consortium Qualified Product List that verifies the following performance metrics: power factor ≥ 90%, CRI ≥80 and THD <10%. The L70 rated life result, as tested by LM-80 or TM-21, shall be a minimum of 50,000 hours. Prior to purchasing, provide documentation to the University to verify compliance.
4. The LED luminaire manufacturer shall provide the name of the LED source manufacturer incorporated into the luminaire.
5. All LED luminaire manufacturers shall provide electrical and photometric data performed in accordance with the IESNA LM-79-08 Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products.
6. 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.
7. The LED luminaire shall have a complete 5 year warranty from date of installation
8. The LED luminaire manufacturer shall version and label products indicating changes in heat sinking, components and component performance.
9. The LED luminaires shall be UL, or ETL listed and be furnished complete with LEDs and power supplies.

C. LED Power Supplies
1. LED power supplies shall operate LEDs within the current limit specification of the manufacturer
2. 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.
3. Shall have short circuit and overload protection.
4. Shall have a minimum starting temperature of 0°F and a maximum case temperature rating of at least 70°C.
5. Power supply output shall be regulated to +/-5% across published load range.
6. Shall have a Class A sound rating.
7. Shall be 100% performance tested at the factory.

8. 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.
9. Shall contain no PCBs.
10. 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.
11. Manufacturer shall have a 15 year history of producing power supplies for the North American market.
12. 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.
    a. Dimmable power supplies shall allow the light output to be maintained at the lowest control setting (prior to off) without dropping out.
    b. Shall be compatible with lighting control systems procured on the project.

D. LED Light Sources(LED packages, arrays, or modules)
1. All LEDs shall have a color temperature of 3500K unless noted otherwise; CRI ≥80.
2. LEDs must stay within a 3-step MacAdam ellipse to maintain target CCT, unless otherwise noted on luminaire schedule.
3. Published LED life ratings shall be based on the point at which LED sources reach L70 lumen maintenance and tested in accordance with IES LM80-08 Approved Method: Testing Lumen Maintenance of LED light sources.
4. L70 rated life shall be a minimum of 50,000 hours.
5. All LED modules, unless noted otherwise, shall be provided by the light fixture manufacturer and integral to the luminaire.
6. 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.
7. Replacement modules should have the ability to be “tuned” to match the ouput of remaining adjacent luminaires in the event that some time has passed and there has been light loss.

E. 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
3. Alzak reflectors and louvers shall be low iridescent equivalent to Coil Anodizers. All alzak parabolic cones shall be guaranteed against discoloration for a minimum of ten years.

F. Wiring
1. Luminaires shall be completely wired at the factory.
2. Internal wiring shall contain no splices.
3. Connections shall be made with insulated "wire nut" type mechanical connectors.
4. Luminaires shall be provided with flexible conduit, pigtails, and equipment for external connections.
5. Provide IC rated luminaires as required by ceiling type.
6. Recessed luminaires installed in inaccessible ceilings shall be UL listed for through wiring with the junction box accessible from the luminaire opening.

G. UL Listing
   1. All Luminaires and components shall be UL tested, listed, and labeled.
   2. Luminaires installed outdoors, under canopies, on roofs, or similar damp or wet locations shall be UL listed and labeled as suitable for damp or wet locations.
   3. Recessed luminaires 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.

2.04 EXTERIOR LIGHTING FIXTURES

A. Enclosures shall be complete with gaskets to form weatherproof seal and UL approved for wet locations.

B. Provide low temperature drivers with reliable starting to 0 degrees F.

C. Luminaire schedule shows style of outdoor luminaires, and basic IESNA distribution patterns.

D. All castings and extrusions shall be given minimum one coat of baked-on clear lacquer, unless painted finish is specified.

E. Aluminum surfaces shall receive a duronodic or polyester power coat paint finish.

F. Provide 1/8” thick x solid neoprene grommets at each point luminaire surfaces are mounted to concrete structure.

2.05 EXIT LIGHTS

A. General Requirements
   1. Exit lights shall be model EXE1RA (single face) or EXE2RA (double face) as indicated on drawings, edge lit LED exit sign made by Tamelite, red letters, AC.

2.06 LIGHTING POLES

A. Lighting poles shall be metal, type and finish as specified in Luminaire Schedule as shown on the drawings.

B. Site lighting poles shall meet wind load rating requirements per local building code.

C. Refer to pole base details as shown on the drawings for specific pole base requirements.

D. The entire pole assembly shall be designed to withstand a steady wind load rating requirements per local building code and a gust factor of 1.3 without permanent deflection.

E. Anchor bolts shall be fabricated from commercial quality galvanized hot rolled carbon steel bar with guaranteed minimum yield strength of 55,000 psi. Bolts shall have an "L" bend on one end. Furnish four bolts and bolt setting template with each set of anchor bolts. Furnish one hex nut, 2 hardened steel washers, and one hex nut with a stainless steel locking pin with each bolt. Bolts, nuts and washers shall be galvanized.

F. Standard finish for pole and accessories shall be a factory applied polyester thermosetting powder coating electro-statically applied to the surface of the substrate to a minimum thickness of 3 mil. Color as specified.

G. Provide and install pole base covers on all poles. Each pole to have internal grounding lug and ground rod.

PART 3 - EXECUTION

3.01 INSPECTION

A. Prior to ordering 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 code, standard, and regulations.

B. Install luminaires 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. Metal decking shall not be pierced for luminaire support.

E. Exit lights installed in grid ceilings shall be supported by electrical box hanger and additional 12ga wire installed from box to structure.

F. Brace suspended luminaires installed near ducts or other construction with solid pendants or threaded rods.

G. Rigidly align continuous rows of luminaires.

H. Luminaire types with remote power supply shall have:
   1. Proper support for power supply weight.
   2. Mounting distance from remote power supply to luminaire per manufacturer's recommendations.

I. Pendant Mounted Fixture:
   1. Pendants shall be length as required to mount at specified mounting height regardless of pendant length noted on fixture schedule.
   2. Refer to sections and architectural drawings for additional information.

J. Surface Mounted Fixture:
   1. Mount with support rails attached to ceiling suspension support system, provided ceiling system has been certified to be suitable to support weight of fixtures.
   2. Where ceiling system has not been certified to support weight of fixtures, fixtures shall be supported at four points near each corner of fixtures and supported from building structure.
   3. Provide a minimum 5/8" air space between the fixture and the ceiling.

K. Recessed Fixtures:
   1. Verify type of ceiling construction and ceiling system prior to releasing luminaires for fabrication and delivery.

2. Handle lenses and down light cones using only new clean white cotton or silk gloves. Do not touch lenses or cones with bare hands. Leave luminaries clean and free of any visible dust, debris, or fingerprints.
3. 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.
4. Recessed downlight luminaires shall be supported with wire hanger, 2 per luminaire, at diagonally opposite corners.
5. Recessed luminaires 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.
6. Connect recessed luminaires to junction box with flexible steel conduit and fixture wire.
7. Ceiling opening frames for recessed luminaires shall be furnished by Electrical Contractor and installed by General Contractor.

L. Pole Mount Lighting
1. Provide in-line fusing at handhole for all pole-mounted luminaries.
2. Provide removable unitized driver/component tray with separable connector in all pole-mounted luminaries.
3. Construct base of concrete with dimension and depth as noted on the drawings.
4. Install anchor bolts with minimum projection above top of bases, as specified by pole manufacturer. Ground as indicated on drawings.
5. Mount standards on bases plumb and true utilizing leveling nuts.
6. Touch up chips and scratches on poles (to match new finish) upon completion.

M. Locations
1. Install luminaires at locations and heights as indicated.
2. Do not scale electrical drawings for locations of luminaires.
3. Architectural reflected ceiling plans show locations of luminaires.
4. Where noted on the drawings, the exact location of luminaires shall be confirmed (in the field) with the Architect/Engineer prior to installation.
    a. Also field verify exact location of the following:
        1) Landscape fixtures
        2) Pedestrian poles
        3) Parking area poles
5. Install luminaires plumb, square, and level with ceilings and walls.
6. Coordinate aircraft cable hanger lengths with job conditions.

N. Ground luminaires and metal poles according to Division 26 Section “Grounding. Install 10ft. driven ground rod at each pole.

O. Install decorative luminaires, reflector cones, baffles, aperture plates, lenses trims, and decorative elements for recessed luminaires after completion of ceiling tile, plastering , painting, and general cleanup is completed. Where luminaire locations or construction does not permit sequential installation, all reflectors, lenses, flanges and other visible surfaces shall be carefully protected.

P. Spare Parts
1. Provide two spare LED boards and drivers for each fixture type.
    a. Spare boards and drivers shall be delivered to Owner in new condition and in original packaging.
    b. Manufacturer and model number shall match those installed in the project's luminaires.
2. Provide spare lenses and guards, 1 for each type.
3. Provide spare reflector cones, 1 for each type.

4. Provide spare plastic diffusers and lenses, 1 for each type.

3.03 LABELING

A. Install “UTA furnished” blue stick-on label on all emergency light fixtures, except exit lights.

3.04 SUBSTANTIAL COMPLETION

A. Lighting Fixtures Adjustment
   1. Verify orientation of directional luminaires prior to installation.
   2. Contractor shall provide electrician’s services to aim, adjust and focus luminaires, to illuminate intended areas as directed, at the direction of Architect/Lighting Designer. Contractor shall provide equipment for luminaires’ focus including ladders and mechanical lifting systems.
   3. These electricians shall be available at times designated by the Architect/Lighting Designer with exterior fixtures being adjusted during hours of darkness.

B. 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.

C. 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.

D. Program preset dimming system lighting levels. Program ambient light sensors for appropriate illumination levels. Program occupancy sensors.

E. LED luminaires may be used in the final finishing of the building.

F. Deliver spare LED boards and drivers to Owner’s representative.

G. Lamp Disposal
   1. The procedure of disposal of lamps that are mercury containing shall follow the guideline set by EPA (definitions in Title 40 Code of Federal Regulations 261 Subpart C, January 2000).

H. Training
   1. Contractor shall provide qualified personnel onsite to provide a minimum of three days of training to Owner's representatives.
   2. This training shall cover:
      a. Luminaire use and maintenance
      b. Architectural lighting system use and maintenance
      c. LED rated life cycles.

END OF SECTION 26 51 00

SECTION 316329 - DRILLED PIERS

PART 2 - GENERAL

2.01 RELATED DOCUMENTS

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

2.02 SUMMARY

A. This Section includes the following:

1. Dry-installed drilled piers.

B. Work Included

1. Furnish all labor and materials required to construct drilled concrete piers complete including layout, excavation of shafts, excavation of belled bottoms, temporary steel casings, fabrication and installation of reinforcing steel, furnishing and placing concrete, setting anchor bolts and removal of spoil.

C. Related Sections include the following:

1. Division 1 Section "Temporary Facilities and Controls."
2. Division 3 Section "Cast-in-Place Concrete" for concrete materials and steel reinforcement.
3. Division 5 Section “Structural Steel” for anchor rods installed in drilled piers.

2.03 UNIT PRICES

A. Basis of Bids: Base bids on indicated number of drilled piers; design length from top elevation to bottom of shaft and diameter of shaft.

B. Basis for Payment: Payment for drilled piers will be made on actual net volume of drilled piers in place and approved. Actual length, shaft diameter may vary to coincide with elevations where satisfactory bearing strata are encountered, and with actual bearing value of bearing strata determined by an independent testing and inspecting agency. Adjustments will be made on net variation of total quantities, based on design dimensions for shafts.

1. Unit prices include labor, materials, tools, equipment, and incidentals required for excavation, trimming, shoring, casings, dewatering, reinforcement, concrete fill, and other items for complete drilled-pier installation.
2. See Division 1 Section "Unit Prices" for list of unit prices.

C. Contract price shall be based on base lengths of piers shown on the Drawings. Unit prices shall be as follows:

1. Unit prices per linear foot for piers longer or shorter than base lengths.
2. Unit prices per linear foot for casing. Measurement for payment shall be from top of pier to top of bearing stratum.

D. The cost of casings shall be included in the base price for piers. If casings are not used, the Contract shall be adjusted based on the unit price.

E. Unit prices shall include all labor and materials including overhead and fees for drilled concrete piers. Adjustments to the Contract shall be based on total linear feet greater than or less than the sum of the base lengths of each pier size. Additional penetration in the bearing stratum greater than the specified penetration shall not be included in determination of increases or decreases of pier lengths related to adjustments in the Contract.

2.04 SUBMITTALS

A. Submittals for Review:

1. Shop Drawings: Indicate dimensioned plan layout, dowel and anchor bolt setting plans including templates, drilled pier shaft sizes, casing sizes, bell bottom sizes, and top elevation, and details of reinforcing steel.

B. Submittals for Information:

1. Pier Drilling Log: Report of drilled concrete pier construction including actual elevations of top and bottom of each pier, elevation of bearing stratum, penetration into bearing stratum, deviations of pier centerline and plumbness, shaft size, bell size, presence of water, use of temporary casing, placement of concrete, and time of start and finish of excavation

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

D. Design Mixes: For each class of concrete. Include revised mix proportions when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Laboratory Test Reports: For evaluation of concrete materials and mix design.

E. Welding certificates.

F. Record drawings at Project closeout according to Division 1 Section "Closeout Procedures."

2.05 QUALITY ASSURANCE

A. Installer: Company specializing in performing the work of this Section with minimum three projects in similar soil and rock conditions, and with similar shaft sizes, depths, and quantities.

B. Drilled-Pier Standard: Comply with provisions in ACI 336.1, "Reference Specifications for the Construction of Drilled Piers," unless modified in this Section.

C. Survey Work: Engage a qualified land surveyor or professional engineer to perform surveys, layouts, and measurements for drilled piers. Before excavating, lay out each drilled pier to lines and levels required. Record actual measurements of each drilled pier's location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.

1. Record and maintain information pertinent to each drilled pier and cooperate with Owner's testing and inspecting agency to provide data for required reports.

D. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 to perform material evaluation tests and to design concrete mixes, as documented according to ASTM E 548.

E. Welding Standards: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."

2. AWS D1.4, "Structural Welding Code--Reinforcing Steel."

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

2.06 PROJECT CONDITIONS

A. Existing Utilities: Locate existing underground utilities before excavating drilled piers. If utilities are to remain in place, provide protection from damage during drilled-pier operations.

1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, adapt drilling procedure if necessary to prevent damage to utilities. Cooperate with Owner and utility companies in keeping services and facilities in operation without interruption. Repair damaged utilities to satisfaction of utility owner.

B. Site Information: A geotechnical report has been prepared for this Project and is included elsewhere in the Project Manual for information only.

1. Information regarding site conditions is provided for the convenience of the Contractor and is not a warranty that the information represents site conditions that may be encountered. The Owner shall not be responsible for interpretations or conclusions drawn from the information provided by the Contractor.
2. Additional borings or other exploratory work may be conducted by the Contractor at no cost to the Owner.

PART 3 - PRODUCTS

3.01 STEEL REINFORCEMENT

A. Refer to Division 03 Section “Cast In Place Concrete.”

B. Bar Supports: Furnish spacers to maintain required concrete cover to sides and bottom of excavation.

1. Shaftspacer Systems, Foundation Technologies, Inc., Tucker, Georgia.
2. "Centraligner" and "Hijacker", Pieresearch, Arlington, Texas.

3.02 CONCRETE MATERIALS

A. Provide concrete materials in accordance with Division 3 “Cast-in-Place Concrete.”

3.03 STEEL CASINGS

A. Steel Pipe Casings: ASTM A 283/A 283M, Grade C; or ASTM A 36/A 36M, carbon-steel plate, with joints full-penetration welded according to AWS D1.1.

PART 4 - EXECUTION

4.01 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by drilled-pier operations.

4.02 EXCAVATION

A. Unclassified Excavation: Excavation is unclassified and includes excavation to bearing elevations regardless of character of materials or obstructions encountered.

1. Obstructions: Unclassified excavation includes removal of unanticipated boulders, concrete, masonry, or other subsurface obstructions.

B. Prevent surface water from entering excavated shafts. Conduct water to site drainage facilities.

C. Excavate shafts for drilled piers to indicated diameters and elevations. Remove loose material from bottom of excavation.

1. Excavate bottom of drilled piers to level plane within 1:12 tolerance.
2. Remove water from excavated shafts before concreting.
3. Excavate rock sockets of dimensions indicated.

D. Notify and allow Owner's testing and inspecting agency to test and inspect bottom of excavation prior to placing reinforcement and concrete. If unsuitable bearing stratum is encountered, make adjustments to drilled piers as determined by Architect.

1. Do not excavate shafts deeper than elevations indicated, unless approved by Architect.
2. Additional authorized excavation will be paid according to Contract provisions for changes in the Work.

E. Excavate shafts for closely spaced drilled piers and those occurring in fragile or sand strata, only after adjacent drilled piers are filled with concrete and allowed to set.

F. Temporary Casings: Install watertight steel casings of sufficient length and thickness to prevent water seepage into shaft; to withstand compressive, displacement, and withdrawal stresses; and to maintain stability of shaft walls.

1. Remove temporary casings, maintained in plumb position, during concrete placement and before initial set of concrete.

G. Bells: Excavate bells for drilled piers to shape, base thickness, and slope angle indicated. Excavate bottom of bells to level plane and remove loose material before concrete is placed.

H. Tolerances: Construct drilled piers to remain within ACI 336.1 tolerances.

1. Maximum Variation From Vertical: One percent of length.
2. Maximum Variation From Design Top Elevation: Plus 1 inch to minus 3 inches.
3. Maximum Out-of-Position: One twenty-fourth of the shaft diameter or 3 inches, whichever is less.
    1. If location or out-of-plumb tolerances are exceeded, provide corrective construction. Submit design and construction proposals to Architect for review before proceeding.

I. Inspection: Each drilled pier must be inspected and tested by Owner's testing and inspecting agency before placing concrete.

1. Provide and maintain facilities with equipment required for testing and inspecting excavations. Cooperate with testing and inspecting personnel to expedite the Work.
2. Notify Architect and testing agency at least six hours before excavations are ready for tests and inspections.

4.03 STEEL REINFORCEMENT

A. Comply with recommendations in CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

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

C. Fabricate and install reinforcing cages symmetrically about axis of shafts in a single unit.

D. Accurately position, support, and secure reinforcement against displacement during concreting. Maintain minimum cover to reinforcement.

E. Use templates to set anchor bolts, leveling plates, and other accessories furnished in work of other Sections. Provide blocking and holding devices to maintain required position during final concrete placement.

F. Protect exposed ends of extended reinforcement, dowels, or anchor bolts from mechanical damage and exposure to weather.

4.04 CONCRETE PLACEMENT

A. Place concrete in continuous operation and without segregation immediately after inspection and approval of shaft by Owner's independent testing and inspecting agency.

1. Concrete shall be placed within the time limit stated on the Drawings.
2. Construct a construction joint if concrete placement is delayed more than one hour. Level top surface of concrete and insert joint dowel bars. Before placing remainder of concrete, clean surface laitance, roughen, and slush concrete with commercial bonding agent or with sand-cement grout mixed at ratio of 1:1.

B. Dry Method: Place concrete to fall vertically down the center of drilled pier without striking sides of shaft or steel reinforcement.

1. Where concrete cannot be directed down shaft without striking reinforcing, place concrete with chutes, tremies, or pumps. Use tremies where a drop of more than 25'-0" is required.
2. Vibrate top 60 inches of concrete.

C. Coordinate withdrawal of temporary casings with concrete placement to maintain at least a 60-inch head of concrete above bottom of casing.

1. Vibrate top 60 inches of concrete after withdrawal of temporary casing.

D. Screed concrete at cutoff elevation level and apply scoured, rough finish. Where cutoff elevation is above the ground elevation, form top section above grade and extend shaft to required elevation.

E. Protect concrete work, according to ACI 301, from frost, freezing, or low temperatures that could cause physical damage or reduced strength.

1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
2. Do not use calcium chloride, salt, or other mineral-containing antifreeze agents or chemical accelerators.

F. When hot-weather conditions exist that would seriously impair quality and strength of concrete, place concrete according to ACI 301 to maintain delivered temperature of concrete at no greater than 95 deg F.

1. Place concrete immediately on delivery. Keep exposed concrete surfaces and formed shaft extensions moist by fog sprays, wet burlap, or other effective means for a minimum of seven days.

4.05 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit reports during excavation and concrete placement for drilled piers.

B. A drilled-pier report will be prepared by Owner's testing and inspecting agency for each drilled pier as follows:

1. Actual top and bottom elevations.
2. Top of rock elevation.
3. Description of soil materials.
4. Description, location, and dimensions of obstructions.
5. Final top centerline location and deviations from requirements.
6. Variation of shaft from plumb.
7. Shaft excavating method.
8. Design and tested bearing capacity of bottom.
9. Depth of rock socket.
10. Levelness of bottom and adequacy of cleanout.
11. Ground-water conditions and water-infiltration rate, depth, and pumping.
12. Description, diameter, and top and bottom elevations of temporary or permanent casings.
13. Description of soil or water movement, sidewall stability, loss of ground, and means of control.
14. Date and time of starting and completing excavation.
15. Inspection report.
16. Position of reinforcing steel.
17. Concrete placing method, including elevation of consolidation and delays.
18. Elevation of concrete during removal of casings.
19. Locations of construction joints.
20. Remarks, unusual conditions encountered, and deviations from requirements.
21. Concrete testing results.

C. Concrete: Refer to Section 03 30 00 for sampling and testing of concrete for quality control.
1. Strength level of concrete will be considered satisfactory if averages of sets of 3 consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi.
2. Test results will be reported in writing to Architect, concrete manufacturer, and Contractor within 24 hours of testing. Reports of compressive-strength tests will contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, concrete type and class, location of concrete batch in drilled pier, design compressive strength at 28 days, concrete-mix proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
3. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as sole basis for acceptance or rejection.
4. Additional Tests: Testing and inspecting agency will make additional tests of concrete when test results indicate concrete strengths or other requirements have not been met.

a. Continuous coring of drilled piers may be required, at Contractor's expense, when temporary casings have not been withdrawn within specified time limits or where observations of placement operations indicate deficient concrete quality, presence of voids, segregation, or other possible defects.

4.06 DISPOSAL OF MATERIALS

A. Remove surplus excavated material and slurry and legally dispose of it off Owner's property.

END OF SECTION 31 63 29

SECTION 32 14 00 - UNIT PAVING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Concrete pavers over sand leveling bed.
   2. ADA Detectable surface pavers set in mortar setting bed.

B. Related Sections:
   1. Division 12 Section - Site Furnishings for coordination with site furnishings installed in areas of pavers.
   2. Division 32 Section " Concrete Paving" for concrete base under unit pavers and for cast-in-place concrete sidewalks and curbs serving as edge restraints for unit pavers.
   3. Division 32 Section - Irrigation for sleeves and coordination with irrigation lines installed under areas of pavers.
   4. Division 33, for coordination with any other utilities installed under areas of pavers.

1.03 SUBMITTALS

A. Product Data: For materials other than water and aggregates.

B. Product Data: For the following:
   1. Pavers.
   2. Mortar and grout materials.

C. Samples for Initial Selection: For the following:
   1. Color selector charts for each type of unit paver indicated.
   2. Joint materials involving color selection.

D. Samples for Verification:
   1. Full-size units of each type and color of unit paver indicated.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of unit paver, joint material, and setting material from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store pavers on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.

B. Store liquids in tightly closed containers protected from freezing.

1.06 PROJECT CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

B. Weather Limitations for Mortar and Grout:
   1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
   2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. Provide artificial shade and windbreaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F and higher.
      a. When ambient temperature exceeds 100 deg F, or when wind velocity exceeds 8 mph and ambient temperature exceeds 90 deg F, set pavers within 1 minute of spreading setting-bed mortar.

PART 2 - PRODUCTS

2.01 CONCRETE PAVERS

A. Concrete Pavers: Solid interlocking paving units complying with ASTM C 936 and resistant to freezing and thawing when tested according to ASTM C 67, made from normal-weight aggregates.
   1. Manufacturers: Subject to compliance with requirements, provide products by Pavestone, or approved equal.
   2. Type 1 Pavers:
      a. Style: Verona Series.
      b. Thickness: 4 inches.
      c. Face Size and Shape: 8" x16" rectangle.
      d. Finish: Standard finish.
      e. Colors: Charcoal
      f. Patterns: As indicated in drawings.
   3. Type 2:
      a. Style: Verona Series.
      b. Thickness: 4 inches.
      c. Face Size and Shape: 8" x 16" rectangle.
      d. Finish: Standard finish.
      e. Color: River Red
      f. Patterns: As indicated in drawings.

B. ADA Detectable Surface Pavers: Provide truncated dome detectable surface precast concrete pavers at curb ramps as indicated in Drawings and where required at curb ramps by authorities having jurisdiction. Pavers as manufactured by Pavestone, Hanover, or equal.
   1. Size: Nominal 3"x4"x8"
   2. Color: As selected by Architect from Manufacturer's standard range.

2.02 ACCESSORIES

A. Compressible Foam Filler: Preformed strips complying with ASTM D 1056, Grade 2A1.

B. Edge Constraint: 4000 Series Heavy Duty Aluminum Edge Restraint, 4" x 3" with standard mill finish as manufactured by Curv-rite, 1-800-366-2878.
   1. Location: All edges not otherwise restrained by concrete sidewalks or curbs.

2.03 LEVELING COURSE

A. Sand for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C 33 for fine aggregate.

B. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16 sieve and no more than 10 percent passing No. 200 sieve.
   1. Provide sand of color needed to produce required joint color.

2.04 MORTAR SETTING-BED MATERIALS

A. Portland Cement: ASTM C 150, Type I or Type II.

B. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed, and not containing a retarder.

C. Thinset Mortar: Latex-modified portland cement mortar complying with ANSI A118.4.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Custom Building Products.
      b. Jamo Inc.
      c. Laticrete International, Inc.
      d. MAPEI Corporation.
      e. Mer-Krete System, ParexLahabra, Inc.
      f. ProSpec.
      g. Southern Grouts & Mortars, Inc.
      h. Summitville Tiles, Inc.
      i. TEC, Specialty Construction Brands, Inc.

D. Water: Potable.

2.05 GROUT MATERIALS

A. Standard Cement Grout: ANSI A118.6, sanded.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Custom Building Products.
      b. Jamo Inc.
      c. Laticrete International, Inc.
      d. MAPEI Corporation.
      e. Mer-Krete System, ParexLahabra, Inc.
      f. ProSpec.
      g. Southern Grouts & Mortars, Inc.
      h. Summitville Tiles, Inc.
      i. TEC, Specialty Construction Brands, Inc.

B. Grout Colors: As selected by Architect from manufacturer's full range>

C. Water: Potable.

2.06 MORTAR AND GROUT MIXES

A. General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing times, and other procedures needed to produce setting-bed and joint materials of uniform quality and with optimum performance characteristics. Discard mortars and grout if they have reached their initial set before being used.

B. Mortar-Bed Bond Coat: Mix neat cement and latex additive to a creamy consistency.

C. Latex-Modified, Portland Cement Setting-Bed Mortar: Proportion and mix portland cement, sand, and latex additive for setting bed to comply with written instructions of latex-additive manufacturer and as necessary to produce stiff mixture with a moist surface when bed is ready to receive pavers.

D. Thinset Mortar Bond Coat: Proportion and mix thinset mortar ingredients according to manufacturer's written instructions.

E. Job-Mixed Portland Cement Grout: Proportion and mix job-mixed portland cement and aggregate grout to match setting-bed mortar except omit hydrated lime and use enough water to produce a pourable mixture.
   1. Colored-Aggregate Grout: Produce color required by combining colored aggregates with portland cement of selected color.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas indicated to receive paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

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

3.02 PREPARATION

A. Remove substances from concrete substrates that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.

B. Sweep concrete substrates to remove dirt, dust, debris, and loose particles.

3.03 INSTALLATION, GENERAL

A. Do not use unit pavers with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.

B. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

C. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.
   1. For concrete pavers, a block splitter may be used.

D. Joint Pattern: As indicated.

E. Tolerances: Do not exceed 1/16-inch unit-to-unit offset from flush (lippage) nor 1/8 inch in 24 inches and 1/4 inch in 10 feet from level, or indicated slope, for finished surface of paving.

F. Expansion and Control Joints: Provide for sealant-filled joints at locations and of widths indicated. Provide compressible foam filler as backing for sealant-filled joints unless otherwise indicated; where unfilled joints are indicated, provide temporary filler until paver installation is complete. Install joint filler before setting pavers. Sealant materials and installation are specified in Division 07 Section "Joint Sealants."

3.04 SAND SETTING-BED OVER CONCRETE APPLICATIONS

A. Install paver edge restraint angles per manfuacturer's written instructions. Install edge restraint angles at all edges of pavers that are not otherwise restrained by concrete curbs or similar construction.

B. Place leveling course and screed to a thickness of 1-1/2 to 2 inches, taking care that moisture content remains constant and density is loose and uniform until pavers are set and compacted.

C. Treat leveling course with herbicide to inhibit growth of grass and weeds.

D. Set pavers to specified tolerances. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 3500- to 5000-lbf compaction force at 80 to 90 Hz. Use vibrator with neoprene mat on face of plate or other means as needed to prevent cracking and chipping of pavers. Perform at least three passes across paving with vibrator.
   1. Compact pavers when there is sufficient surface to accommodate operation of vibrator, leaving at least 36 inches of uncompacted pavers adjacent to temporary edges.
   2. Before ending each day's work, compact installed concrete pavers except for 36-inch width of uncompacted pavers adjacent to temporary edges (laying faces).
   3. As work progresses to perimeter of installation, compact installed pavers that are adjacent to permanent edges unless they are within 36 inches of laying face.
   4. Before ending each day's work and when rain interrupts work, cover pavers that have not been compacted and cover leveling course on which pavers have not been placed with nonstaining plastic sheets to protect them from rain.

E. Spread dry sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.

F. Do not allow traffic on installed pavers until sand has been vibrated into joints.

G. Repeat joint-filling process 30 days later if joints show evidence of settling or of joints that are not completely filled.

3.05 MORTAR SETTING-BED APPLICATIONS

A. Saturate concrete sub-base with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.

B. Apply mortar-bed bond coat over surface of concrete sub-base about 15 minutes before placing mortar bed. Limit area of bond coat to avoid its drying out before placing setting bed. Do not exceed 1/16-inch thickness for bond coat.

C. Apply mortar bed over bond coat; spread and screed mortar bed to uniform thickness at subgrade elevations required for accurate setting of pavers to finished grades indicated.

D. Mix and place only that amount of mortar bed that can be covered with pavers before initial set. Before placing pavers, cut back, bevel edge, and remove and discard setting-bed material that has reached initial set.

E. Place pavers before initial set of cement occurs. Immediately before placing pavers on mortar bed, apply uniform 1/16-inch thick bond coat to mortar bed or to back of each paver with a flat trowel.

F. Tamp or beat pavers with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Set each paver in a single operation before initial set of mortar; do not return to areas already set or disturb pavers for purposes of realigning finished surfaces or adjusting joints.

G. Spaced Joint Widths: Provide 3/8-inch.

H. Grouted Joints: Grout paver joints complying with ANSI A108.10.

I. Grout joints as soon as possible after initial set of setting bed.
   1. Force grout into joints, taking care not to smear grout on adjoining surfaces.
   2. Clean pavers as grouting progresses by dry brushing or rubbing with dry burlap to remove smears before tooling joints.

3. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
4. If tooling squeezes grout from joints, remove excess grout and smears by dry brushing or rubbing with dry burlap and tool joints again to produce a uniform appearance.

J. Cure grout by maintaining in a damp condition for seven days unless otherwise recommended by grout or liquid-latex manufacturer.

3.06 REPAIRING, POINTING, AND CLEANING

A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

B. Pointing: During tooling of joints, enlarge voids or holes and completely fill with grout. Point joints at sealant joints to provide a neat, uniform appearance, properly prepared for sealant application.

C. Cleaning: Remove excess grout from exposed paver surfaces; wash and scrub clean.

END OF SECTION 32 14 00

SECTION 32 15 43 - AGGREGATE PATHWAY

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes material and labor requirements for construction with decomposed granite pathway.

B. Related Sections:
   1. Section 31 00 00 - Earthwork

1.02 PERFORMANCE REQUIREMENTS

A. Perform gradation of decomposed granite material crushed aggregate in accordance with ASTM C 136 - Method for Sieve Analysis for Fine and Course Aggregates.

1.03 SUBMITTALS

A. Product Data: For each product specified submit a 5 lb. sample and sieve analysis for grading of decomposed granite aggregate to Owner prior to any construction.

B. Shop Drawings: Show details of installation, including plans and sections.

C. Maintenance Instructions: Submit copy (or copies) of manufacturer's written maintenance instructions in accordance with Specifications to Owner as part of Close Out documents at Substantial Completion.

1.04 PROJECT/SITE CONDITIONS

A. Field Measurements: Each bidder is required to visit the site of work to verify the existing conditions. No adjustments will be made to the Contract Sum for variations in the existing conditions.

B. Where surfacing is indicated to fit with other construction, verify dimensions of other construction by field measurements before proceeding with the work.

C. Environmental Limitations: Do not install Stabilized Aggregate pathway during rainy conditions or below 40 degrees Fahrenheit and falling.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Installer to provide evidence to indicate successful experience in providing Stabilized Aggregate Decomposed Granite surface or ability to follow installation instructions prior to beginning construction.

B. Compaction testing to be provided by contractor, one test per 2,000 square feet of base course.

C. Manufacturer's technical representative shall visit the site at the start of an installation to ensure the installer understands the correct installation methods to use. Installer shall arrange and coordinate technical representative’s visit with General Contractor, and Owner’s Representative.

1.06 WARRANTY

A. Warranty Period: Contractor shall provide warranty for performance of product. Contractor shall warranty installation of product for the time of one year from completion.

B. Contractor shall provide, for a period of sixty days, unconditional maintenance and repairs as required.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Stabilizer for Stabilized Aggregate Decomposed Granite surfaces shall be Stabilizer® as provided by Stabilizer Solutions, Inc. 33 South 28th Street, Phoenix, AZ 85034; phone (602) 225-5900, (800) 336-2468; fax (602) 225- 5902; website stabilizersolutions.com; email info@stabilizersolutions.com, or approved equal.

2.02 MATERIALS

A. Decomposed Granite screenings
   1. Sand and crushed stone shall consist of inert materials that are hard and durable, with stone free from surface coatings and deleterious materials. Gradation requirements shall be as follows:
   2. Crushed Stone Sieve Analysis Percentage of Weight Passing a Square Mesh Sieve AASHTO T11-82 and T2782

1/4" MINUS AGGREGATE GRADATION

U.S. Sieve No.	Percent Passing by Weight
# 3/8"	100
#4	90 - 100
#8	75 - 80
#16	55 - 65
#30	40 - 50
#50	25 - 35
#100	15 - 20
# 200 to	10 - 15

B. Binder
   1. Patented, non-toxic, organic binder that is a colorless and odorless concentrated powder that binds decomposed granite aggregate.
   2. Product shall have 25 years' experience at same formulation.

2.03 EXCESS MATERIALS

A. Provide Owner's authorized representative with the following excess materials for use in future Stabilized Aggregate Decomposed Granite repair: 40 to 50 lb. Bags of the Stabilized Aggregate blended with proper amount of Binder.

PART 3 - EXECUTION

3.01 PREPARATION

A. Base shall be 3" compacted layer of TXDOT recommended crushed granular road base. Make any corrections necessary to base furnished and installed to bring gravel to the elevations shown on the drawing.

B. Pre-soak base material with water and compact to 95% determined by Test Method ASTM D 1557 prior to installing Stabilized Aggregate. Compaction testing to be provided by project owner, one test per 2,000 square feet of base.

C. Install Decomposed Granite to ensure no standing water on surface or adjacent to Stabilized Aggregate, including downspouts when placed under roof overhang and surface drains, within 4 hours of a rain event.

D. Before proceeding with installation, notify Owner's Representative in writing of unsuitable site/base conditions. To proceed with installation of Decomposed Granite shall be an acknowledgement by the Installer that conditions meet the specifications as described herein.

3.02 BINDER

A. The Binder shall be thoroughly pre-mixed with aggregate at the rate of Stabilizer® or approved equal to ton of aggregate based on manufacturer's recommendation for installation in Arlington, Texas. Verify with manufacturer correct rates prior to installation. Binder shall not be drop-spread over pre-placed aggregate nor mixed by rototilling. The Binder shall be mechanically pre-mixed per manufacturer's recommendations using an approved mechanical blending unit to adequately blend The Binder with aggregate. Bucket blending shall not be an approved blending apparatus. The Binder and aggregate shall be blended DRY.

3.03 PLACEMENT

A. After pre-blending, place Stabilized Aggregate directly on prepared sub-grade. Level to desired grade and cross section. Depth of Stabilized Aggregate shall be 2" over 3" depth sub-grade at a minimum. DO NOT place on filter fabric.

3.04 WATERING

A. Water heavily for full-depth moisture penetration of profile. Water activates The Binder. Apply 25 to 45 gallons of water per 1-ton to achieve saturation. Randomly test for depth using a probing device, which reaches full depth.

B. Contractor shall wait a minimum of 6 - 72 hours or until such time that the Stabilized Aggregate is able to accept compaction from a 1- to 5-ton roller without separation, plowing, or any other physical compromise of the aggregate.

C. If surface aggregate dries significantly quicker than subsurface material, lightly mist surface before compaction.

3.05 COMPACTION

A. Compact Stabilized Aggregate to 85% relative compaction by equipment such as a 2- to 5-ton double drum roller making 3 to 4 passes. Do not begin compaction for 6 hours after placement and up to 72 hours. DO NOT use a vibratory plate compactor or vibration feature on roller, as vibration separates large aggregate particles. If pumping or pancaking of surface occurs, surface is still too wet to roll.

B. Take care in compacting surface when adjacent to planting and irrigation systems, use 8" or 10" hand tamp. Installation of Stabilized Aggregate more than 3" thick shall be installed in lifts. If 4" thick compacted (2) 2" lifts. If 5" thick compacted (2) 2.5" lifts.

C. Lightly spray surface area following compaction. Do not disturb aggregate surface with spray action.

3.06 INSPECTION

A. Finished surface shall be smooth, uniform and solid with no evidence of chipping or cracking. Cured and compacted pathway shall be firm throughout profile with no spongy areas. Loose material shall not be present on surface after installation, but may appear after use and according to environmental conditions. Pathway shall remain stable underneath loose granite on top with a "natural" look. Any significant irregularities in path surface shall be repaired to the uniformity of entire installation.

3.07 PROTECTION

A. Contractor shall furnish and install construction fence around new surface to prevent public access. Fencing shall be maintained in place for a minimum of 12 - 72 hours after completion of installation, or as directed by the Owner's Representative. Drying period may take longer due to weather conditions.

B. Contractor shall notify Owner's Representative that landscape irrigation shall be restricted near Stabilized Aggregate surface until drying period is complete. Standing water on surface and adjacent to path shall be restricted at all times.

3.08 MAINTENANCE

A. Remove debris, such as paper, grass clippings, or organic material by mechanically blowing or hand raking as needed. When plowing snow, use rubber baffle on plow blade or wheels on plow to lift blade 1/4" off the surface.

B. During first year, minor amounts of loose aggregate may appear on surface (1/16 to 1/4"). If material exceeds a 1/4", redistribute over entire surface. Water to 1" depth and compact with power roller of no less than 1000-lbs. Repeat as needed. If cracking occurs, sweep fines into cracks, water thoroughly and hand tamp with an 8" - 10" hand tamp.

3.09 REPAIRS

A. Excavate damaged area to the depth of the Stabilized Aggregate and square off sidewalls.

B. If area is dry, moisten damaged portion lightly.

C. Pre-blend the dry required amount of Stabilizer with the proper amount of aggregate in a concrete mixer.

D. Add water to the pre-blended Stabilized Aggregate. Thoroughly moisten mix with 25 to 45 gallons per 1-ton of pre-blended material or to approximately 10% moisture content.

E. Apply moistened pre-blended Stabilized Aggregate to excavated area to finish grade.

F. Compact with an 8" to 10" hand tamp or 250- to 300-pound roller. Keep traffic off areas for 12 to 48 hours after repair has been completed.

END OF SECTION 32 15 43

SECTION 32 17 00 - PAVEMENT SPECIALTIES

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. Parking barriers.
   2. Precast concrete curbs.
   3. Striping & directional paint markings.
   4. Detectable Warning Mats.

B. Related Sections include the following:
   1. Division 03 Section- "Concrete".
   2. Division 32 Section - "Paving".
   3. Division 32 Section - "Unit Paving".

1.03 GENERAL

A. Furnish all labor, materials, services, equipment and appliances required for pavement specialty work indicated on the drawings and specified herein.

1.04 JOB CONDITIONS:

A. Condition of pavement: Clean, dry and cured minimum amount of time as recommended by striping paint manufacturer.

1.05 SUBMITTALS

A. Submit manufacturer's literature to the Architect for approval. Literature shall show compatibility of product proposed for use with paving surface to which product is to be applied.

B. Samples for initial selection: Manufacturer's standard selector samples or printed material showing accurate color rendition, for warning mats and concrete bollards.

C. Shop Drawings: Show footing design, and attachment details of pavment specialties to adjacent construction. Include dimensioned site plan for location of bollards and detectable mats, coordinated with Contractor's field-verified dimensions.

1.06 COORDINATION OF WORK

A. Contractor and subcontractor for work of this section shall be jointly responsible for the coordination of the work specified herein, including but not limited to:
   1. Fire Lanes: Coordinate with all governing authorities to determine exact requirements (whether or not shown on the drawings). Fire lane marking, if required, is part of the work of the base contract.
   2. Handicapped Parking Spaces: Coordinate with all governing authorities to determine exact requirements (whether or not shown on the drawings). Special marking, if required, is part of the work of the base contract.
   3. Colors: Coordinate color requirements with all governing authorities, use only acceptable colors. Colors specified herein shall be used, if acceptable.

4. Notification: Notify the Owner of any required variation from the drawings resulting from coordination.

1.07 PROTECTION

A. Protect newly painted surfaces from damage by vehicles during the time required for paint to harden sufficiently to withstand traffic. Any damage to newly painted markings due to the paint subcontractor's failure to provide adequate protection shall be repaired by him at no additional cost to the Owner.

1.08 GUARANTEE AND WARRANTIES

A. Pavement Markings:
   1. Any work found to be defective due to poor workmanship or defective materials within a 60-day evaluation period from Substantial Completion will immediately be replaced at no additional cost to the Owner. A new 60-day evaluation period will commence upon repair. Contractors One-Year corrective period shall also be enforced as a remedy by Owner for continued deteriorating paint installation.

B. Concrete Bollards: Manufacturer's standard 1-year warranty against manufacture defects.

C. Warning Mats: Manufacturer's standard 5-year warranty covering defects in materials and workmanship.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Parking Barriers: Precast concrete, semicircular or beveled square in cross-section 6" high x 8" wide x 6'-0" long with holes for minimum anchoring dowels.

B. Precast Concrete Curbs: Precast concrete, beveled front top edge in cross-section, 7 3/8" tall x 18" deep x 24" wide with keyed end condition for securing together in series. All edges to be radiused. Lay loose in sand bed.

C. Detectable Warning Mats: Mechanically-fastened, surface applied, Ultraviolet resistant, glass reinforced thermoset composite material equal to Detectable Warning Systems', "AlertTile".
   1. Size: 24" wide x 60" long, or approved equal.
   2. Detectable Surface: Truncated domes at approximate 2.35" centers.
   3. Slip Resistance Coefficients: Dry: 1.03, Wet 0.83.
   4. Color: Gray. Integral color throughout and resistant to UV fading.
   5. Edges: Beveled edges compliant with Texas Accessibility Requirements for wheelchair path of travel.
   6. Anchors: Manufacturer's recommended stainless steel expansion anchors for use with existing substrate(s). Unless otherwise recommended by manufacturer, use expansion bolts of type that do not use plastic inserts.

D. Striping & Directional Marking Paint: Acrylic parking lot and/or street marking paint, recommended by manufacturer for type of surface.
   1. Paint type: Acrylic, water-borne pavement marking paint conforming to Texas Dept. of Highways Special Specification Traffic paint.
   2. Color:
      a. General Use Striping, Directional Marking, & H.C. Marking: Manufacturer's standard flat white.

b. At line striping in drive aisles and roads that is located between opposite directions of traffic, use traffic yellow.
c. Fire Lane Striping: Manufacturer's standard red or as per city code. Fire lane striping shall have lettering stenciled in white at 40' intervals, to read: "NO PARKING-FIRE LANE", or as required by local fire codes and regulatory authorities.

PART 3 - EXECUTION

3.01 PREPARATION

A. Removal of existing pavement markings: Where indicated in plan, and as inferred by new striping shown in areas of existing striping, remove existing striping completely by sand blasting or other method acceptable to Engineer and that will cause negligible damage to existing paving and surface texture. Power wash and clean paving to prepare surface for new pavement markings in accordance with paint manufacturer's recommendations.

B. New concrete surfaces will be allowed to cure for a period of not less than 11 days before application of marking materials.

C. Dust, clay, silt and excess sand will be removed (by sweeping) from the pavement to be marked before application of paint.

D. Prior to beginning work, confirm requirements of regulatory authorities for pavement markings including colors. Where TxDOT or other authority has jurisdiction, confirm their requirements. Locate the fire lane striping on horizontal paving surface or on entire concrete curbs as required by local authorities. Where fire lanes are painted in a radiused arc across drive aisle, confirm acceptable radius dimension with local authorities for fire lane striping.

3.02 INSTALLATION:

A. Equipment: Spray mechanism capable of applying paint at the rate specified at an even and uniform thickness, with clear cut edges. Mechanism shall be operated by means of quick opening and closing valves conveniently located.

B. Striping & Marking:
1. Where pavement is trowel or wood float finish concrete, lightly sandblast immediate area to receive striping prior to application of paint.
   a. Rough broom finish areas will not require sand-blasting.
2. Apply paint in accord with manufacturer's written instructions. Apply at a rate of one gallon spread evenly over an area of 105 SF± five square feet and a wet film thickness of 0.015 inch (15 mils.).
3. Paint 4" wide lines in patterns and spacing as shown on drawings. Width of the lines shall be within a tolerance of one-half inch. The centerline of marking shall not deviate more than one-half inch laterally from a straight line at any point.
4. Parking Striping:
   a. Painted lines: 4" wide, generally 20' long, and spaced approximately 9' O.C. except where noted or local authorities require otherwise.
   b. If the overall space divides equally into slightly larger spacing than 9', individual spaces should be increased equally, but should not in any case be less than 9' O.C., unless noted otherwise on drawings.

C. Parking Barrier: Drill hole through pavement surface for steel rods to secure barrier in place. Barrier shall be centered between paint stripes. Minimum 2 #5 rods per barrier extended below paving surface and countersink 1/2" below top surface of barrier. At asphalt paving, extend 24" below paving.

D. Detectable Warning Mats: Install mats per manufacturer's installation instructions for indicated paving substrate(s).

E. Pre-Cast Concrete Bollards: Install per manufacturer' installation instructions and as follows:
   1. Coordinate footing locations with the work of other trades that may be affected.
   2. Locate footing locations and achoring inserts accurately per approved shop drawings and manfacturer's requirements. Maintain alignments as indicated in Drawings.
   3. Provide concrete footing with cast-in anchors or dowels as required per manufacturer's recommendations, or as detailed in Drawings. Or if footing is not otherwise recommended by Manufacturer or detailed in Drawings to minimum size of 12" diameter x 3' deep with #3 reinforcing in two vertical "stirrups" at 90 degrees and to each other and (3) #3's horizontal at equal spacing. Concrete used for footing shall be equal to or exceeding precast concrete bollard concrete strength. Footing to be installed to manufacturer's requirements if more stringent.
   4. If paving installer is other than bollard installer, coordinate all requirements with concrete paving and footing installer, prior to forming concrete paving.

F. Pre-Cast Concrete Bollard Caps for Pipe Bollards: Install according to Manufacturer's installation instructions.

3.03 CLEANING

A. Any spilled paints shall be cleaned from the paved areas to the satisfaction of the Owner. Keep the premises clean at all times.

B. Paint, empty containers, and other materials or equipment shall not be stored or allowed to accumulate on, or near the paved areas.

C. Upon completion of work of this section remove related debris from premises.

END OF SECTION 32 17 00

SECTION 32 32 23 - RETAINING WALL SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes: Furnishing and installing segmental retaining wall (SRW) units and appurtenant materials required for construction of the retaining wall, as shown on the construction drawings to the lines and grades designated on the construction drawings.

B. Related Documents: The Contract Documents, as defined in Division 01 Section - Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other documents.

C. Related Sections include:
   1. Division 01 Section: Information Available to Bidders

1.03 REFERENCE STANDARDS

A. Segmental Retaining Wall Units
   1. ASTM C 140 - Sampling and Testing Concrete Masonry Units

B. Geosynthetic Reinforcement
   1. ASTM D 4595 - Tensile Properties of Geotextiles by the Wide-Width Strip Method.
   2. ASTM D 5262 - Test Method for Evaluating the Unconfined Creep Behavior of Geosynthetics
   3. GRI:GG1 - Single Rib Geogrid Tensile Strength
   4. GRI:GG5 - Geogrid Pullout

C. Soils
   1. ASTM D 698 - Moisture Density Relationship for Soils, Standard Method
   2. ASTM D 422 - Gradation of Soils
   3. ASTM 4318 - Atterberg Limits of Soil

D. Drainage Pipe
   1. ASTM 3034 - Specification for Polyvinyl Chloride (PVC) Plastic Pipe
   2. ASTM D1248 - Specification for Corrugated Plastic Pipe

E. Where specifications and reference documents conflict, the Architect/Engineer shall make the final determination of applicable document.

1.04 SUBMITTALS

A. Material Submittals: The Contractor shall submit manufacturers' certifications two weeks prior to start of work stating that the SRW units and geosynthetic reinforcement meet the requirements of this specification.

B. Design Submittal: The Contractor shall submit two sets of detailed design calculations and construction drawings for approval at least two weeks prior to the beginning of wall construction. All calculations and drawings shall be prepared and sealed by a professional Civil Engineer (Wall Design Engineer) experienced in SRW wall design and licensed in the state where the wall is to be built.

1.05 DELIVERY, STORAGE AND HANDLING

A. Contractor shall check materials upon delivery to assure that specified type and grade of materials have been received and proper color and texture of SRW units have been received.

B. Contractor shall prevent excessive mud, wet concrete, epoxies, and like materials which may affix themselves, from coming in contact with materials.

C. Contractor shall store and handle materials in accordance with manufacturer's recommendations.

D. Contractor shall protect materials from damage. Damaged materials shall not be incorporated into the retaining wall.

1.06 DESIGN REQUIREMENTS

A. Wall design shall be based on geotechnical report prepared for the project.

B. Should the actual soil conditions observed during construction differ from those assumed for the design, design shall be reviewed by the Wall Design Engineer and revised if required by existing conditions.

C. The design provided by the Contractor and prepared by the Wall Design Engineer shall consider the internal and local stability of the reinforced soil mass and shall be in accordance with acceptable engineering practice and these specifications. External stability including bearing capacity, global stability, and total and differential settlement is the responsibility of the Owner or the Owner's Geotechnical Engineer.

D. For constructability considerations, maximum vertical spacing between geogrid layers shall be 2.0 feet.

PART 2 - PRODUCTS

2.01 SEGMENTAL RETAINING WALL UNITS

A. SRW units shall be limetstone blocks to match limestone selected for landscape benches.

B. Finish of SRW units shall be honed

C. SRW unit faces shall be of straight geometry.

D. SRW unit height shall be 24 inches.

E. SRW Unit width shall be 18 inches

F. SRW units (not including aggregate fill in unit voids) shall provide a minimum weight of 105 psf wall face area.

G. SRW units shall be solid through the full depth of the unit.

H. SRW units shall be interlocked with connection pins, designed with proper setback to provide 8:1 vertical to horizontal batter (a 7 degree cant from vertical).

I. SRW units shall be capable of being erected with the horizontal gap between adjacent units not exceeding 1/8 inches.

J. For any corners shown on the construction plans, SRW units shall be capable of providing overlap of units on each successive course so that walls meeting at corner are interlocked and continuous. SRW units that require corners to be mitered shall not be allowed.

K. SRW units shall be capable of providing a split face, textured surface for all vertical surfaces that will be exposed after completion of wall, including any exposed sides and backs of units.

L. SRW units shall be sound and free of cracks or other defects that would interfere with the proper placing of the unit or significantly impair the strength or permanence of the structure. Cracking or excessive chipping may be grounds for rejection. Units showing cracks longer

than 1/2" shall not be used within the wall. Units showing chips visible at a distance of 30 feet from the wall shall not be used within the wall.

M. SRW units' molded dimensions shall not differ more than + 1/8 inch from that specified, except height which shall be + 1/16 inch as measured in accordance with ASTM C140.

2.02 SEGMENTAL RETAINING WALL UNIT CONNECTION PINS

A. SRW units shall be interlocked with connection pins. The pins shall consist of glass-reinforced nylon made for the expressed use with the SRW units supplied.

2.03 GEOSYNTHETIC REINFORCEMENT

A. Geosynthetic reinforcement shall consist of geogrids or geotextiles manufactured as a soil reinforcement element and recommended by wall manufacturer. The manufacturers/suppliers of the geosynthetic reinforcement shall have demonstrated construction of similar size and types of segmental retaining walls on previous projects.

B. The type, strength, and placement location of the reinforcing geosynthetic shall be as determined by the Wall Design Engineer, as shown on their final, sealed construction plans.

2.04 LEVELING PAD

A. Material for leveling pad shall consist of compacted sand, gravel, or combination thereof and shall be a minimum of 6 inches in depth. Lean concrete with a strength of 200-300 psi and three inches thick maximum may also be used as a leveling pad material. The leveling pad should extend laterally at least a distance of 6 inches from the toe and heel of the lowermost SRW unit.

2.05 DRAINAGE AGGREGATE

A. Drainage aggregate shall be angular, clean stone or granular fill meeting the following gradation as determined in accordance with ASTM D422

Sieve Size	Percent Passing
3/4 inch	75-100

2.06 DRAINAGE PIPE

A. The drainage collection pipe shall be a perforated or slotted PVC, or corrugated HDPE pipe. The drainage pipe may be wrapped with a geotextile to function as a filter.

B. Drainage pipe shall be manufactured in accordance with ASTM D 3034 and/or ASTM D 1248

2.07 REINFORCED (INFILL) SOIL

A. The reinforced soil material shall be free of debris. Unless otherwise noted on plans prepared by the Wall Design Engineer, the reinforced material shall consist of the inorganic USCS soil types GP, GW, SW, SP, SM meeting the following gradation, as determined in accordance with ASTM D422:

Sieve Size	Percent Passing

B. The maximum particle size of poorly-graded gravels (GP) (no fines) should not exceed 3/4 inch unless geosynthetic strength is reduced to account for additional installation damage from particles larger than this maximum.

C. The plasticity of the fine fraction shall be less than 20.

PART 3 - EXECUTION

3.01 EXCAVATION

A. Contractor shall excavate to the lines and grades shown on the project grading plans. Contractor shall take precautions to minimize over-excavation. Over-excavation shall be filled with compacted infill material, or as directed by the Engineer/Architect, at the Contractor's expense.

B. Contractor shall verify location of existing structures and utilities prior to excavation. Contractor shall ensure all surrounding structures are protected from the effects of wall excavation. Excavation support, if required, is the responsibility of the Contractor

3.02 FOUNDATION PREPARATION

A. Following the excavation, the foundation soil shall be examined by the Owner's Engineer to assure actual foundation soil strength meets or exceeds the assumed design bearing strength. Soils not meeting the required strength shall be removed and replaced with infill soils, as directed by the Owner's Engineer.

B. Foundation soil shall be proofrolled and compacted to 95% standard Proctor density and inspected by the Owner's Engineer prior to placement of leveling pad materials.

3.03 LEVELING PAD CONSTRUCTION

A. Leveling pad shall be placed as shown on the construction drawings with a minimum thickness of 6 inches. The leveling pad should extend laterally at least a distance of 6 inches from the toe and heel of the lower most SRW Unit.

B. Soil leveling pad material shall be compacted to provide a firm, level bearing surface on which to place the first course of units. Well-graded sand can be used to smooth the top 1/2 to 1/4 inch of the leveling pad. Compaction will be with mechanical plate compactors to achieve 95% of maximum standard Proctor density (ASTM D 698).

3.04 SRW UNIT INSTALLATION

A. All SRW units shall be installed at the proper elevation and orientation as shown on the wall profiles and details on the construction plans or as directed by the Engineer. The SRW units shall be installed in general accordance with the manufacturer's recommendations. The specifications and drawings shall govern in any conflict between the two requirements.

B. First course of SRW units shall be placed on the leveling pad. The units shall be leveled side-to-side, front-to-rear and with adjacent units, and aligned to ensure intimate contact with the leveling pad. The first course is the most important to ensure accurate and acceptable results. No gaps shall be left between the front of adjacent units. Alignment may be done by means of a string line or offset from base line to the back of the units.

C. Clean all excess debris from top of units and install next course.

D. Insert two connection pins through pin holes of each upper course unit into receiving slots in lower course units. Pins shall be fully seated in the pin slot below. Push units forward to remove any looseness in the unit-to-unit connection and then check alignment. Check level and alignment of the units.

E. Lay out of curves and corners shall be installed in accordance with the plan details or in general accordance with SRW manufacturer's installation guidelines. Walls meeting at corners shall be interlocked by overlapping successive courses.

F. Repeat procedures to extent of wall height.

G. The wall face cant shall not differ more than + 2 degrees from that specified.

3.05 GEOSYNTHETIC REINFORCEMENT PLACEMENT

A. All geosynthetic reinforcement shall be installed at the proper elevation and orientation as shown on the wall profiles and details on the final construction plans or as directed by the Engineer.

B. At the elevations shown on the final plans, the geosynthetic reinforcement shall be laid horizontally on compacted infill and on top of the concrete SRW units. Embedment of the geosynthetic in the SRW units shall be consistent with SRW manufacturer's recommendations. Correct orientation of the geosynthetic reinforcement shall be verified by the Contractor to be in accordance with the geosynthetic manufacturer's recommendations. The highest strength direction of the geosynthetic must be perpendicular to the wall face.

C. Geosynthetic reinforcement layers shall be one continuous piece for their entire embedment length. Overlap of the geosynthetic in the design strength direction (perpendicular to the wall face) shall not be permitted.

D. Tracked construction equipment shall not be operated directly on the geosynthetic reinforcement. A minimum of 6 inches of backfill is required prior to operation of tracked vehicles over the geosynthetic. Turning should be kept to a minimum. Rubber-tired equipment may pass over the geosynthetic reinforcement at slow speeds (less than 5 mph).

E. The geosynthetic reinforcement shall be in tension and free of wrinkles prior to placement of soil fill. The nominal tension shall be applied to the reinforcement and secured in place with staples, stakes or by hand tensioning until reinforcement is covered by six inches of fill.

3.06 DRAINAGE MATERIALS

A. Drainage aggregate shall be installed to the line, grades, and sections shown on the final plans. Drainage fill shall be placed to the minimum thickness shown on the construction plans between and behind units.

B. Drainage collection pipes shall be installed to maintain gravity flow of water outside the reinforced soil zone. The drainage collection pipe shall daylight into a storm sewer manhole or along a slope at an elevation lower than the lowest point of the pipe within the aggregate drain.

3.07 BACKFILL PLACEMENT

A. The reinforced backfill shall be placed as shown in the construction plans in the maximum compacted lift thickness of 10 inches and shall be compacted to a minimum of 95% of standard Proctor density (ASTM D 698) at a moisture content within 2% of optimum. The backfill shall be placed and spread in such a manner as to eliminate wrinkles or movement of the geosynthetic reinforcement and the SRW units.

B. Only hand-operated compaction equipment shall be allowed within 3 feet of the front of the wall face. Compaction within the 3 feet behind the wall face shall be achieved by at least three (4) passes of a lightweight mechanical tamper, plate, or roller.

C. At the end of each day's operation, the Contractor shall slope the last level of backfill away from the wall facing to direct water runoff away from the wall face.

D. At completion of wall construction, backfill shall be placed level with final top of wall elevation. If final grading, paving, landscaping, and/or storm drainage installation adjacent to the wall is not placed immediately after wall completion, temporary surface drainage shall be provided to ensure water runoff is not directed at the wall nor allowed to collect or pond behind the wall until final construction adjacent to the wall is completed.

3.08 SRW CAPS

A. SRW caps shall be properly aligned and glued to underlying units with Versa-Lok concrete adhesive or an equivalent, flexible, high-strength concrete adhesive. Rigid adhesive or mortar are not acceptable.

B. Caps shall overhang the top course of units by 3/4 to 1 inch. Slight variation in overhang is allowed to correct alignment at the top of the wall.

3.09 CONSTRUCTION ADJACENT TO COMPLETED WALL

A. The Owner or Owner's Representative is responsible for ensuring that construction adjacent to the wall by others does not disturb the wall or place temporary construction loads on the wall that exceed design loads, including loads such as water pressure, temporary grades, or equipment loading. Heavy paving or grading equipment shall be kept a minimum of three feet behind the back of the wall face. Equipment with wheel loads in excess of 150 psf live load shall not be operated with 10 feet of the face of the retaining wall during construction adjacent to the wall. Care should be taken by the General Contractor to ensure water runoff is directed away from the wall structure until final grading and surface drainage collection systems are completed.

END OF SECTION 32 32 23