

**Project Manual and
Specifications**

Queen of the Holy Rosary Catholic Church Hostyn, Texas

The Diocese of Victoria

**Project #1024-0623
July 2, 2025**



SECTION 00 01 10 - TABLE OF CONTENTS

TECHNICAL SPECIFICATIONS

DIVISION 00 – INTRODUCTORY INFORMATION

- 00 01 10 TABLE OF CONTENTS
- 00 01 15 LIST OF DRAWINGS

DIVISION 01 – GENERAL REQUIREMENTS

- 01 21 00 ALLOWANCES
- 01 23 00 ALTERNATES
- 01 25 00 SUBSTITUTION PROCEDURES
- 01 25 01 SUBSTITUTION REQUEST FORM
- 01 29 00 PAY APPLICATIONS
- 01 30 00 ADMINISTRATIVE REQUIREMENTS
- 01 31 00 PROJECT MEETINGS
- 01 32 16 CONSTRUCTION PROGRESS SCHEDULE
- 01 33 00 SUBMITAL PROCEDURES
- 01 41 00 TESTING LABORATORY SERVICES
- 01 45 00 QUALITY CONTROL
- 01 50 00 TEMPORARY FACILITIES AND CONSTRUCTION
- 01 60 00 EXTRA STOCK
- 01 64 00 OWNER FURNISHED ITEMS
- 01 77 00 PROJECT CLOSEOUT
- 01 78 39 RECORD DOCUMENTS, AS-BUILT DRAWINGS



DIVISION 02 – SITE CONSTRUCTION

- 02 32 00 GEOTECHNICAL INVESTIGATION
- 02 41 00 DEMOLITION

DIVISION 03 – CONCRETE

- 03 10 00 CONCRETE FORMWORK
- 03 20 00 CONCRETE REINFORCEMENT
- 03 30 00 CAST-IN-PLACE CONCRETE
- 03 31 00 EPOXY RELATED WORK

DIVISION 04 – MASONRY

- 04 20 00 UNIT MASONRY
- 04 85 20 NATURAL VENEER STONE

DIVISION 05 – METALS

- 05 12 00 STRUCTURAL STEEL
- 05 20 00 STEEL JOISTS
- 05 31 00 STEEL ROOF DECK

05 31 20 STEEL FORM DECK
05 40 00 COLD-FORMED METAL FRAMING
05 50 00 METAL FABRICATIONS

DIVISION 06 - WOOD PLASTICS AND COMPOSITES

06 10 00 ROUGH CARPENTRY
06 20 00 FINISH CARPENTRY
06 61 19 QUARTZ SURFACE FABRICATIONS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

07 19 16 WATER REPELLENT
07 21 00 THERMAL AND ACOUSTICAL INSULATION
07 26 16 BELOW GRADE VAPOR RETARDERS
07 27 20 FLUID APPLIED AIR BARRIER
07 41 13 METAL ROOF PANELS
07 42 16 METAL SOFFIT PANELS
07 54 16 KETONE ETHYLENE ESTER (KEE) BASED SHEET ROOFING
07 62 00 SHEET METAL FLASHING AND TRIM
07 65 00 FLEXIBLE FLASHING SELF-ADHERING
07 72 33 ROOF HATCHES
07 84 00 FIRESTOPPING
07 90 00 JOINT SEALANTS

DIVISION 08 - OPENINGS

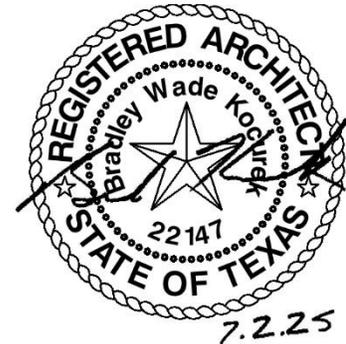
08 11 00 METAL DOORS AND FRAMES
08 14 00 WOOD DOORS
08 31 00 ACCESS DOORS AND FRAMES
08 41 00 ALUMINUM DOORS WINDOWS AND FRAMES
08 71 00 DOOR HARDWARE
08 80 00 GLAZING

DIVISION 09 – FINISHES

09 21 13 PLASTER ASSEMBLIES
09 21 16 GYPSUM BOARD ASSEMBLIES
09 30 00 TILING
09 51 13 ACOUSTICAL PANEL CEILINGS
09 65 13 RESILIENT WALL BASE
09 65 16 COMMERCIAL VINYL FLOORING (LVT)
09 66 00 TERRAZZO FLOORING
09 83 13 MODULAR FLOORING
09 84 14 ACOUSTIC STRETCHED FABRIC SYSTEMS
09 90 00 PAINTING AND COATING
09 97 23 CONCRETE FLOOR SEALER

DIVISION 10 - SPECIALTIES

10 01 00 MISCELLANEOUS SPECIALTIES



10 14 00 GRAPHICS
10 21 13 HIGH DENSITY POLYMER (HDP) TOILET PARTITIONS
10 28 13 TOILET ROOM ACCESSORIES
10 44 00 FIRE PROTECTION SPECIALTIES
10 73 10 PROTECTIVE COVERS

DIVISION 12 - FURNISHINGS

12 24 00 WINDOW SHADES
12 34 10 CASEWORK

DIVISION 20- GENERAL PROVISIONS

SEE SEPARATE INDEX FOR MEP SPECS

DIVISION 21 – FIRE PROTECTION

21 13 00 FIRE-SUPPRESSION SPRINKLER SYSTEMS

DIVISION 22 – PLUMBING

SEE SEPARATE INDEX FOR MEP SPECS

DIVISION 23 - HEATING, VENTILATION AND AIR CONDITIONING

SEE SEPARATE INDEX FOR MEP SPECS

DIVISION 26 - ELECTRICAL

SEE SEPARATE INDEX FOR MEP SPECS

DIVISION 27 - COMMUNICATIONS

27 41 15 SOUND REINFORCING SYSTEM

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

28 46 00 FIRE ALARM & DETECTION SYSTEM

DIVISION 31 – EARTHWORK

31 11 00 SITE CLEARING AND GRUBBING
31 23 00 EXCAVATION AND FILL
31 31 16 TERMITE CONTROL

DIVISION 32 – EXTERIOR IMPROVEMENTS

32 13 13 CONCRETE PAVING (SITE WORK CONCRETE)

END OF SECTION 00 01 10



DIVISION 20, 21, 22 & 23

QUEEN OF THE HOLY ROSARY

CATHOLIC CHURCH

DIOCESE OF VICTORIA

MECHANICAL SPECIFICATIONS

CONTENTS:

20 00 00..... GENERAL PROVISIONS

20 01 00..... BASIC MATERIALS AND METHODS

20 02 00..... SCHEDULE OF VALUES

20 07 00..... INSULATION

21 00 00..... FIRE PROTECTION

22 01 00..... INSIDE UTILITY TRENCH EXCAVATION, BACKFILL AND COMPACTION

22 02 00..... OUTSIDE UTILITY TRENCH EXCAVATION, BACKFILL AND COMPACTION

22 11 16..... WATER DISTRIBUTION SYSTEM

22 11 17..... WATER HEATERS

22 13 16..... LIQUID WASTE TRANSFER

22 30 00..... PLUMBING FIXTURES AND TRIM

23 05 93..... TEST AND BALANCE

23 08 02..... EQUIPMENT START-UP

23 09 00..... CONTROLS (NATIVE BACNET)

23 11 23..... FUEL GAS SYSTEM (NATURAL)

23 30 00..... AIR DISTRIBUTION

23 70 00..... MECHANICAL EQUIPMENT: D-X SYSTEMS

23 70 70..... VRV HVAC SYSTEMS AND CONTROLS

23 99 95..... COMMISSIONING OF MECHANICAL SYSTEMS



B.J. Hendrix
07/02/2025
F-4095

DIVISION 26 & 28

QUEEN OF THE HOLY ROSARY

CATHOLIC CHURCH

DIOCESE OF VICTORIA

ELECTRICAL SPECIFICATIONS

CONTENTS:

26 05 00	GENERAL PROVISIONS
26 05 10	SCHEDULE OF VALUES
26 05 19	WIRE & CABLE
26 05 26	GROUNDING & BONDING
26 05 29	HANGER & SUPPORTING DEVICES
26 05 33	RACEWAYS
26 05 34	OUTLET BOXES, PULL BOXES & JUNCTION BOXES
26 05 80	EMPTY RACEWAY ROUGH-IN
26 24 13	MAIN SWITCHBOARD
26 24 16	BRANCH CIRCUIT PANELBOARDS
26 27 26	DEVICES
26 28 10	MANUAL MOTOR STARTERS
26 28 15	SAFETY DISCONNECT SWITCH
26 28 16	FUSES
26 28 20	COMBINATION MOTOR STARTERS
26 28 25	CONTACTORS
26 41 13	LIGHTNING PROTECTION SYSTEM
26 43 00	SURGE PROTECTIVE DEVICES
26 51 00	INTERIOR LIGHTING SYSTEM
26 56 00	EXTERIOR LIGHTING SYSTEM
26 99 95	COMMISSIONING OF ELECTRICAL SYSTEMS
28 46 00	FIRE ALARM SYSTEM



B.J. Hendrix
07/02/2025
F-4095

SECTION 00 01 15 – LIST OF DRAWINGS

GENERAL

- G1.1 COVER SHEET
- G1.2 ADA DETAILS AND MOUNTING HEIGHTS
- G2.1 CODE REVIEW
- G3.1 ARCHITECTURAL SITE PLAN
- G3.2 ARCHITECTURAL DEMOLITION SITE PLAN



CIVIL

- C2.0 EXISTING CONDITIONS AND DEMO PLAN
- C3.0 SITE PLAN
- C4.0 UTILITY PLAN
- C5.0 GRADING PLAN
- C6.0 DETAILS

LANDSCAPE (REFERENCE ONLY)

- L1.0 LANDSCAPE PLAN
- L1.1 LANDSCAPE NOTES & DETAILS PLAN
- L1.2 SLEEVING PLAN

STRUCTURAL

- S1-1 FOUNDATION PLAN
- S1-2 ROOF FRAMING PLAN
- S1-3 ENLARGED TOWER PLANS
- S2-1 FOUNDATION DETAILS
- S2-2 FOUNDATION DETAILS
- S3-1 FRAMING DETAILS
- S3-2 FRAMING DETAILS
- S3-3 FRAMING DETAILS
- S3-4 FRAMING DETAILS
- S4-1 GENERAL NOTES

ARCHITECTURAL

- A1.1 FLOOR PLAN
- A1.2 DIMENSION PLAN
- A1.3 MEZZANINE & CLERESTORY PLAN
- A1.4 ROOF PLAN
- A1.5 DROP-OFF, TOWER, & RESTROOM PLANS
- A2.1 WALL TYPES
- A2.2 ALTAR PLANS & DETAILS

- A2.3 PLAN DETAILS
- A2.4 PLAN DETAILS
- A3.1 REFLECTED CEILING PLAN
- A3.2 CEILING DETAILS
- A4.1 EXTERIOR ELEVATIONS
- A4.2 EXTERIOR ELEVATIONS
- A4.3 EXTERIOR ELEVATIONS
- A4.4 EXTERIOR ELEVATIONS
- A4.5 EXTERIOR AXONOMETRICS
- A5.1 BUILDING SECTIONS
- A5.2 BUILDING SECTIONS
- A5.3 WALL SECTIONS
- A5.4 WALL SECTIONS
- A5.5 WALL SECTIONS
- A5.6 WALL SECTIONS
- A6.1 ROOF DETAILS
- A6.2 SECTION & ROOF DETAILS
- A6.3 SECTION DETAILS
- A7.1 DOOR SCHEDULE, DETAILS & WINDOW ELEVATIONS
- A7.2 HEAD, JAMB, AND SILL DETAILS
- A8.0 MATERIAL SCHEDULE
- A8.1 FINISH PLAN
- A8.2 ENLARGED PEW LAYOUT PLANS
- A8.4 INTERIOR ELEVATIONS
- A8.5 INTERIOR ELEVATIONS
- A8.6 INTERIOR ELEVATIONS
- A9.1 INTERIOR & MILLWORK/ CASEWORK ELEVATIONS



MECHANICAL

- M1.1 SCHEDULES, NOTES, AND LEGENDS - MECHANICAL
- M1.2 SCHEDULES - MECHANICAL
- M1.3 SCHEDULES - MECHANICAL
- M1.6 DETAILS - MECHANICAL
- M1.7 DETAILS - MECHANICAL
- M2.1 FIRST FLOOR PLAN - MECHANICAL

ELECTRICAL

- E1.0 SITE PLAN - ELECTRICAL
- E1.1 SCHEDULES, NOTES, AND LEGENDS - ELECTRICAL
- E1.2 SCHEDULES - ELECTRICAL
- E1.3 RISER DIAGRAMS - ELECTRICAL
- E1.4 PANEL SCHEDULES - ELECTRICAL
- E1.5 DETAILS - ELECTRICAL
- E2.1 FIRST FLOOR PLAN - LIGHTING
- E2.2 CLERESTORY & TOWER PLANS - LIGHTING
- E3.1 FIRST FLOOR PLAN - POWER

PLUMBING

- P1.1 SCHEDULES, NOTES, AND DETAILS - PLUMBING
- P1.2 SCHEDULES - PLUMBING
- P1.10 DETAILS - PLUMBING
- P1.11 DETAILS - PLUMBING
- P2.1 FIRST FLOOR PLAN - PLUMBING - WASTE
- P3.1 FIRST FLOOR PLAN - PLUMBING - SUPPLY



FIRE PROTECTION

- F2.1 FIRE PROTECTION PLAN - FIRST FLOOR

AUDIO/VIDEO

- AV0.0 AV DEVICE LEGEND AND POWER ADVISORY
- AV0.1 AV CONDUIT DIAGRAM
- AV1.1 AV FIRST FLOOR PLAN
- AV3.1 AV REFLECTED CEILING PLAN LEVEL-1
- AV5.1 AV BUILDING SECTIONS
- AV5.2 AV BUILDING SECTIONS 2
- AV6.0 AV PLATE DETAILS
- AV6.1 AV RACK ELEVATION
- AV10.0 AV ONE LINE DIAGRAM

END OF SECTION 00 01 15

SECTION 01 21 00 - ALLOWANCES

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies administrative and procedural requirements governing handling and processing allowances.
 - 1. Selected materials and equipment, and in some cases, their installation are shown and specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. Additional requirements, if necessary, will be issued by Change Order.
- B. Types of allowances required include the following:
 - 1. Lump sum allowances.
 - 2. Contingency allowance.
 - 3. Inspection and testing allowances.
- C. Allowance amounts shall be transferable to other allowances as directed by the Architect.

1.2 SELECTION AND PURCHASE

- A. At the earliest feasible date after Contract award, advise the Architect of the date when the final selection and purchase of each product or system described by an allowance must be completed in order to avoid delay in performance of the Work.
 - 1. When requested by the Architect, obtain proposals for each allowance for use in making final selections; include recommendations that are relevant to performance of the Work.
 - 2. Purchase products and systems as selected by the Architect from the designated service organization or supplier.

1.3 SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.
- B. Submit invoices or delivery slips to indicate actual quantities of materials delivered to the site for use in fulfillment of each allowance.

1.4 CONTINGENCY ALLOWANCES

- A. Use the contingency allowance only as directed for the Owner's purposes, and only by Contingency Fund Change Orders which designate amounts to be charged to the allowance.
 - 1. The Contractor's related costs for products or equipment ordered by the Owner under the contingency allowance, including delivery, installation, taxes, insurance, equipment rental, and similar costs are not part of the Contract Sum.
 - 2. Change Orders authorizing use of funds from the contingency allowance will not include the Contractor's related costs and reasonable overhead and profit margins.

Contractor shall include in base bid, Contractor's overhead, profit, insurance, bond and other direct cost.

3. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order or transfer the remaining amounts to other allowances as directed by the Architect.

1.5 UNUSED MATERIALS

- A. Return unused materials to the manufacturer or supplier for credit to the Owner, after installation has been completed and accepted.
- B. Where it is not economically feasible to return unused material for credit and when requested by the Architect, prepare unused material for the Owner's storage, and deliver to the Owner's storage space as directed. Otherwise, disposal of excess material is the Contractor's responsibility.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect products covered by an allowance promptly upon delivery for damage or defects.

3.2 PREPARATION

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

3.3 SCHEDULE OF ALLOWANCES

- A. Allowance No. 1 - Contingency: Include a contingency allowance of Thirty Thousand Dollars (**\$30,000**) in the Base Proposal for coordination, installation and finish-out of baptismal font shell provided by Owner.

END OF SECTION 01 21 00

SECTION 01 23 00 - ALTERNATES

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

PART 1 - GENERAL

1.1 SUMMARY

A. Identification and description of Alternates.

1.2 RELATED REQUIREMENTS

A. Proposal Documents: Cost of each Alternate.

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

C. Sections of Specifications identified in each Alternate.

1.3 PROCEDURES

A. Alternate will be exercised and added to the proposed Contract Sum at the option of the Owner.

B. For any or all alternates selected or otherwise approved for adding or deducting from the Contract Sum by the Owner, coordinate related Work and modify surrounding Work as required to complete the Work, including changes under each Alternate, only if acceptance is designed in Owner-Contractor Agreement.

C. Owner reserves the right to accept or reject Alternates for 180 days after Proposals are received.

1.4 LIST OF ALTERNATES

ALTERNATE NO. 1: ADD to provide Marion "M" set in terrazzo floor as indicated on sheet A8.1 and detail A11/A8.0.

ALTERNATE NO. 2: ADD to provide acoustic wall panels APS3 in Narthex as indicated on drawings and specified herein.

ALTERNATE NO. 3: ADD to provide acoustic ceiling panels APS1 & APS2 on ceilings in Nave, and Chapel as indicated on drawings and specified herein.

ALTERNATE NO. 4: ADD to provide planters and associated foundation as indicated on sheet G3.1, and structural drawings.

ALTERNATE NO. 5: ADD to provide lighted bollards S3 as indicated on sheet G3.1, and electrical drawings. All conduits, boxes, and wiring to bollards shall be part of the base bid.

END OF SECTION 01 23 00

SECTION 01 25 00 - SUBSTITUTION PROCEDURES

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

PART 1 - GENERAL

A. RELATED DOCUMENTS

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

B. SUMMARY

1. Section includes administrative and procedural requirements for substitutions.
2. Related Sections:
 - a. Division 01 Section "Allowances" for products selected under an allowance.
 - b. Division 01 Section "Alternates" for products selected under an alternate.
 - c. Division 01 Section "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.
 - d. Divisions 02 through 49 Sections for specific requirements and limitations for substitutions.

C. DEFINITIONS

1. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - a. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - b. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

D. SUBMITTALS

1. Substitution Requests: Submit copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - a. Substitution Request Form
 - b. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 1. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
 2. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
 3. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable specification section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 4. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 5. Samples, where applicable or requested.

6. Certificates and qualification data, where applicable or requested.
 7. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 8. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 9. Research reports evidencing compliance with building code in effect for Project
 10. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 11. Cost information, including a proposal of change, if any, in the Contract Sum.
 12. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
 13. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
- c. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven (7) days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within fifteen (15) days of receipt of request, or seven (7) days of receipt of additional information or documentation, whichever is later.
1. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 2. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

E. QUALITY ASSURANCE

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

F. PROCEDURES

1. Coordination: Modify or adjust affected work as necessary to integrate work of the approved substitutions.

PART 2 - PRODUCTS

A. SUBSTITUTIONS

1. Substitutions during Bidding: Bids are to be based exactly on the construction documents. Include the materials, manufacturers and processes specified. No substitutions may be used unless they are incorporated into the construction documents by addenda. All substitution requests must be submitted at least five (5) days prior to the proposal receipt date. Provide sufficient technical information on substitution items to allow the Architect to make equitable comparison with specified items.
2. Substitutions for Cause: Submit requests for substitution immediately upon discovery of need for change, but not later than (30) days prior to time required for preparation and review of related submittals.

3. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume.
 - b. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - c. Substitution request is fully documented and properly submitted.
 - d. Requested substitution will not adversely affect Contractor's construction schedule.
 - e. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - f. Requested substitution is compatible with other portions of the Work.
 - g. Requested substitution has been coordinated with other portions of the Work.
 - h. Requested substitution provides specified warranty.
 - i. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
4. Substitutions for Convenience: Allowed
5. Substitutions for Convenience: Architect will consider requests for substitution if received within sixty (60) days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.
 - a. Conditions: Architect will consider Contractor's request for substitution only when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 2. Requested substitution does not require extensive revisions to the Contract Documents.
 3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 4. Substitution request is fully documented and properly submitted.
 5. Requested substitution will not adversely affect Contractor's construction schedule.
 6. Requested substitution has received necessary approvals of authorities having jurisdiction.
 7. Requested substitution is compatible with other portions of the Work.
 8. Requested substitution has been coordinated with other portions of the Work.
 9. Requested substitution provides specified warranty.
 10. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

END OF SECTION 01 25 00

SUBSTITUTION REQUEST FORM

Project: _____ Substitution Request Number: _____

From: _____
To: _____ Date: _____

A/E Project Number: _____
Re: _____ Contract For: _____

Specification Title: _____ Description: _____
Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____
Manufacturer: _____
Address: _____ Phone: _____
Trade Name: _____ Model: _____
Installer: _____
Address: _____ Phone: _____
History: New product 1-4 years old 5-10 years old More than 10 years old
 Point-by-point comparative data attached

Reason for not providing specified item: _____
Similar Installation: _____
Project: _____ Address: _____
Architect: _____ Owner: _____
Date Installed: _____

Proposed substitution affects other parts of Work: No Yes; explain _____

Savings to Owner for accepting substitution: _____ (\$ _____)

Proposed substitution changes Contract Time: No Yes; explain _____

Supporting Data Attached: Drawings Product Data Samples Tests Reports _____

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

_____ Telephone: _____

Attachments: _____

A/E's REVIEW AND RECOMMENDATION

- Approve Substitution - Make submittals in accordance with Specification Section 01 25 00 Substitution Procedures.
- Approve Substitution as noted - Make submittals in accordance with Specification Section 01 25 00 Substitution Procedures.
- Reject Substitution - Use specified materials.
- Substitution Request received too late - Use specified materials.

Signed by: _____ Date: _____

OWNER'S REVIEW AND ACTION

- Substitution approved - Make submittals in accordance with Specification Section 01 25 00 Substitution Procedures. Prepare Change Order.
- Substitution approved as noted - Make submittals in accordance with Specification Section 01 25 00 Substitution Procedures. Prepare Change Order.
- Substitution rejected - Use specified materials.

Signed by: _____ Date: _____

Additional Comments:

Contractor Subcontractor Supplier Manufacturer A/E

END OF SECTION 01 25 01

SECTION 01 29 00 – PAY APPLICATIONS

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

SUMMARY

- A. This Section specifies administrative and procedural requirements governing the Contractor's Applications for Payment.
 - 1. Coordinate the Schedule of Values and Applications for Payment with the Contractor's Construction Schedule, Submittal Schedule, and List of Subcontracts.
 - 2. Coordinate the Schedule of Values breakdown and format requirements with the Architect.

RELATED SECTIONS

- A. Section 01 33 00 – Submittal Procedures

SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the Schedule of Values with preparation of the Contractor's Construction Schedule.
 - 1. Correlate line items in the Schedule of Values with other required administrative schedules and forms, including:
 - a. Contractor's Construction Schedule.
 - b. Application for Payment forms, including Continuation Sheets.
 - c. List of subcontractors.
 - d. Schedule of alternates.
 - e. List of products.
 - f. List of principal suppliers and fabricators.
 - g. Schedule of submittals.
 - 2. Submit the Schedule of Values to the Architect at the earliest possible date but no later than 14 days after date of GMP Amendment.
- B. Format and Content: Use the Project Manual table of contents as a guide to establish the format for the Schedule of Values. Provide at least one-line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the Schedule of Values:
 - a. Project name and location.
 - b. Name of the Architect.
 - c. Project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 - 2. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section
 - b. Description of Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value.
 - 3. Percentage of Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
 - 4. Provide a breakdown of the Contract Sum, per Project Phase in sufficient detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Break principal subcontract amounts down into several line items.

5. Round amounts to nearest whole dollar; the total shall equal the Contract Sum.
6. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment, purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. Include requirements for insurance and bonded warehousing, if required. Provide documentation for items stored off-site.
8. Provide separate line items on the Schedule of Values for initial cost of the materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
9. Margins of Cost: Show line items for indirect costs and margins on actual costs only when such items are listed individually in Applications for Payment. Each item in the Schedule of Values and Applications for Payment shall be complete. Include the total cost and proportionate share of general overhead and profit margin for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at the Contractor's option.
10. Schedule Updating: Update and resubmit the Schedule of Values prior to the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum. List each Change Order as a separate line item.

APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by the Architect and paid for by the Owner.
 1. The initial Application for Payment, the Application for Payment at time of Substantial Completion, and the final Application for Payment involve additional submittal requirements.
- B. Payment-Application Times: Each progress-payment date is indicated in the Agreement. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment-Application Forms: Use AIA Document G702 and Continuation Sheets G703 as the form for Applications for Payment.
- D. Application Preparation: Complete every entry on the form. Include notarization and execution by a person authorized to sign legal documents on behalf of the Contractor. The Architect will return incomplete applications without action.
 1. Entries shall match data on the Schedule of Values and the Contractor's Construction Schedule. Use updated schedules if revisions were made.
 2. Include amounts of Change Orders and Construction Change Directives issued prior to the last day of the construction period covered by the application.
- E. Transmittal: Submit electronic copies of each Application for Payment to the Architect by a method ensuring receipt within 24 hours. Application shall be complete, including waivers of lien and similar attachments.
 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information related to the application, in a manner acceptable to the Architect.
- F. Waivers of Mechanics Lien: With each Application for Payment, submit waivers of mechanics lien from every entity who is lawfully entitled to file a mechanics lien arising out of the Contract and related to the Work covered by the payment.
 1. Submit partial waivers on each item for the amount requested, prior to deduction for retainage, on each item.

2. Submit final Applications for Payment with or proceeded by final waivers from every entity involved with performance of the Work covered by the application that is lawfully entitled to a lien.
 3. The Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Waiver Forms: Submit waivers of lien on forms, and executed in a manner, acceptable to the Owner.
- G. Initial Application for Payment: Administrative actions and submittals, that must precede or coincide with submittal of the first Application for Payment, include the following:
1. List of subcontractors.
 2. List of principal suppliers and fabricators.
 3. Schedule of Values.
 4. Contractor's Construction Schedule (preliminary if not final).
 5. Schedule of principal products.
 6. Submittal Schedule (preliminary if not final).
 7. List of Contractor's staff assignments.
 8. Copies of building permits.
 9. Copies of authorizations and licenses from governing authorities for performance of the Work.
 10. Initial progress report.
 11. Report of preconstruction meeting.
 12. Certificates of insurance and insurance policies.
- H. Application for Payment at Substantial Completion: Following issuance of the Certificate of Substantial Completion, submit an Application for Payment.
1. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
 2. Administrative actions and submittals that shall precede or coincide with this application include:
 - a. Certificate of Occupancy and similar approvals.
 - b. Warranties (guarantees) and maintenance agreements.
 - c. Record Documents.
 - d. Test/adjust/balance records.
 - e. Maintenance instructions.
 - f. Meter readings.
 - g. Startup performance reports.
 - h. Changeover information related to Owner's occupancy, use, operation, and maintenance.
 - i. Final cleaning.
 - j. Advice on shifting insurance coverage's.
 - k. List of incomplete Work (punch list), recognized as exceptions to Architect's Certificate of Substantial Completion.
- I. Final Payment Application: Administrative actions and submittals that must precede or coincide with submittal of the final Application for Payment include the following:
1. Completion of Project closeout requirements.
 2. Completion of items specified for completion after Substantial Completion.
 3. Ensure that unsettled claims will be settled.
 4. Ensure that incomplete Work is not accepted and will be completed without undue delay.
 5. Transmittal of required Project construction records to the Owner.
 6. Proof that taxes, fees, and similar obligations were paid.
 7. Removal of temporary facilities and services.

8. Removal of surplus materials, rubbish, and similar elements.
9. Change of door locks to Owner's access.

END OF SECTION 01 29 00

SECTION 01 30 00 – ADMINISTRATIVE REQUIREMENTS

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

CONTRACT FORMS

A. The following standard forms issued by the American Institute of Architects will be used on this project:

1. Standard Form of Agreement Between Owner and Construction Manager as Constructor	A 133	2019
2. General Conditions of the Contract for Construction	A 201	2017
3. Performance Bond and Payment Bond	A 312	1992
4. Application and Certificate for Payment	G 702	1992
5. Continuation Sheet	G 703	1992
6. Change Order	G 701	2001
7. Certificate of Substantial Completion	G 704	2000
8. Contractor's Affidavit of Payment of Debts and Claims	G 706	1994
9. Consent of Surety Company to Final Payment	G 707	1994
10. Consent of Surety Company to Reduction in or Partial Release of Retainage	G 707A	1994

ADVERTISING

A. The Contractor or any Subcontractors shall not advertise or publish without the Owner's prior consent, the fact that the Owner has entered into this contract, except to the extent necessary to comply with proper requests for information from an authorized representative of the federal, state or local government.

SCHEDULING THE WORK

- A. The work shall be carefully scheduled and executed in a manner that will cause the least possible interference with the Owner's operations and property.
- B. Prior to beginning the actual work, the Architect, Contractor and Owner's representative will meet to discuss the final scheduling and coordination of the work.

RIGHT OF ENTRY

- A. The Owner reserves the right of entry to the property at all times for inspection of the work.
- B. The Owner may perform collateral work or have work under separate contracts performed on the property. Owner must coordinate work performed under separate contracts with the Contractor and must grant the Contractor time extensions to his contract if such additional work causes delays.

PROGRESS MEETINGS

A. The Contractor shall meet with the Architect and Owner's representative as often as necessary to maintain communications between all parties as may be necessary to maintain scheduling and

execution of the work in a manner that is least disruptive to the Owner. Refger to Section 01 31 00 – Project Meetings.

MAINTENANCE MANUALS

- A. Furnish the Owner four (4) copies of maintenance recommendations for all work installed.
- B. Maintenance recommendations shall be furnished in a form approved by the Architect and shall be neatly typewritten and bound.

MANUFACTURER'S DIRECTIONS

- A. All manufactured articles, materials, appliances and equipment shall be applied, installed, connected, erected, used, cleaned, conditioned and placed in operation as directed by the representative manufacturers, insofar as these directions are applicable to this particular project and are not in conflict with superior requirements in the specifications.

ASBESTOS

- A. The General Contractor shall provide certification from himself, all Subcontractors, vendors, suppliers, entities, etc. stating that materials and/or equipment used in the construction of the project do not contain asbestos in any form or concentration. **MSDS sheets on all materials used must be provided.**

CONTRACTOR RESPONSIBILITY

The Contractor will be working on an active occupied site and shall follow the following:

- 1. Have workers wear hard hats at all times for the purpose of identifying the individual as a construction worker.
- 2. Provide on a weekly basis to the designated owner representative, a description of the work activities for the week. The weekly work agenda will include the name of the responsible contractor group leader, areas in which work will take place, approximate number of workers on site that day, approximate arrival and departure times, and the scheduled work activity.
- 3. Schedule worker arrival and departure times as not to interfere with mass times.
- 4. Maintain contractor's own restroom facilities as required in Specification Section 015000 Temporary Facilities. The contractor will not be permitted use of the campus restroom facilities.
- 5. All workers shall be dressed appropriately in a clean and neat manner. No offensive or vulgar language/art can be displayed. The Owner reserves the right to remove any worker from the site immediately.

PROTECTION OF PROPERTY & PERSONS

- A. Protect existing site structures, monuments, walks, curbing, sidewalks, drives, parking lots, planting beds, shrubs, trees and lawn areas. All damage caused by the Contractor or any Subcontractors shall be made good at the expense of the Contractor.

- B. Provide necessary barricades / fencing / covers to protect persons during the course of the work or during periods when no work is in progress but when conditions around the construction areas could pose a danger.

COMPLIANCE WITH LAW

- A. During performance of his work, Contractor shall comply with all Federal, State and City Laws and Regulations.

DEBRIS REMOVAL

- A. Contractors shall remove all debris resulting from the work being performed to a suitable site for disposal, and shall dispose of same in a manner that does not violate any City, State or Federal Law or Regulation.

END OF SECTION 01 30 00

SECTION 01 31 00 – PROJECT MEETINGS

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

SUMMARY

- A. This Section specifies the General Contractor's administrative and procedural requirements for project meetings, including the following:
1. Pre-construction conferences.
 2. Pre-installation conferences.
 3. Progress meetings.
 4. Coordination meetings.

RELATED REQUIREMENTS

- A. Section 01 33 00 – Submittal Procedures: Submitting the Contractor's Construction Schedule.
- B. Individual Specification Sections for pre-installation conference requirements.

PRE-CONSTRUCTION CONFERENCE

- A. Schedule a Pre-Construction conference before starting construction, at a time convenient to the Owner and the Architect, and within the time frame established by the Owner for commencement of the Work. Hold the conference at the Project Site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.
- B. Attendees: Authorized representatives of the Owner, Architect, and their consultants, the Contractor and its superintendent, major subcontractors, manufacturers, and suppliers, and other concerned parties shall attend the conference. All participants at the conference shall be familiar with the Project and authorized to conclude matters relating to the Work.
- C. Agenda: Discuss items of significance that could affect progress, including the following:
1. Tentative construction schedule.
 2. Approved Product List.
 3. Critical work sequencing including phasing.
 4. Designation of responsible personnel.
 5. Procedures for processing field decisions and Change Orders.
 6. Procedures for processing Applications for Payment.
 7. Distribution of Contract Documents.
 8. Submittal of Shop Drawings, Product Data, and Samples.
 9. Preparation of Record Documents.
 10. Use of the premises.
 11. Parking availability.
 12. Office, work, and storage areas.
 13. Equipment deliveries and priorities.
 14. First aid.
 15. Security.
 16. Housekeeping.
 17. Working hours.

PRE-INSTALLATION CONFERENCES

- A. Conduct a Pre-installation Conference at the Project Site before each construction activity that requires coordination with other construction. Determine which activity will require Pre-installation Conference at project startup meeting.
- B. Attendees: The installer and representatives of manufacturers and fabricators involved in or affected by the installation, and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise the Architect of scheduled meeting dates.
 1. Review the progress of other construction activities and preparations for the particular activity under consideration at each pre-installation conference, including requirements for the following:
 - a. Options.
 - b. Related Change Orders.
 - c. Shop Drawings, Product Data, and quality-control samples.
 - d. Review of mockups.
 - e. Possible conflicts.
 - f. Time schedules.
 - g. Weather limitations.
 - h. Manufacturer's recommendations.
 - i. Warranty requirements.
 - j. Compatibility of materials.
 - k. Acceptability of substrates.
 - l. Temporary facilities.
 - m. Space and access limitations.
 - n. Governing regulations.
 - o. Safety.
 - p. Inspecting and testing requirements.
 - q. Required performance results.
 - r. Recording requirements.
 - s. Protection.
- C. Record significant discussions and agreements and disagreements of each conference, and the approved schedule. Promptly distribute the record of the meeting to everyone concerned, including the Owner and the Architect.
- D. Do not proceed with the installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of Work and reconvene the conference at the earliest feasible date.

PROGRESS MEETINGS

- A. Conduct progress meetings at the Project Site twice monthly. Notify the Owner and the Architect of scheduled meeting dates. Coordinate dates of meetings with preparation of the payment request. Two days prior to progress meeting distribute printed agenda to all projected attendees.
- B. Attendees: In addition to representatives of the Owner and the Architect, each subcontractor, supplier, or other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with the Project and authorized to conclude matters relating to the Work.

- C. Agenda: Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the status of the Project.
1. Contractor's Construction Schedule: Review progress since the last meeting. Determine where each activity is in relation to the Contractor's Construction Schedule, whether on time or ahead or behind schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to insure that current and subsequent activities will be completed within the Contract Time.
 2. Review the present and future needs of each entity present, including the following:
 - a. Interface requirements.
 - b. Time.
 - c. Sequences.
 - d. Status of submittals.
 - e. Deliveries.
 - f. Off-site fabrication problems.
 - g. Access.
 - h. Site utilization.
 - i. Temporary facilities and services.
 - j. Hours of work.
 - k. Hazards and risks.
 - l. Housekeeping.
 - m. Quality and work standards.
 - n. Change Orders.
 - o. Documentation of information for payment requests.
 - p. Modification of construction work schedule or activities required to accommodate Owner's continued use and activities at the site.
- D. Reporting: No later than 3 days after each meeting, distribute minutes of the meeting to each party present and to parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.
- E. Schedule Updating: Revise the Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue the revised schedule concurrently with the report of each meeting.

END OF SECTION 01 31 00

SECTION 01 32 16 – CONSTRUCTION PROGRESS SCHEDULE

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

PART 1 GENERAL

1.1 SUBMITTALS

- A. Schedules:
1. Preliminary Analysis: Within ten (10) days after approval of Guaranteed Maximum Price, submit a preliminary construction schedule for review by Owner and Architect.
 2. Construction Schedule: Within fourteen (14) days after receipt of Notice to Proceed, submit one (1) reproducible and four (4) prints of the approved construction schedule.
 3. Updated Construction Schedule(s): Within 48 hours (2 working days) of request, provide Architect one (1) copy of revised construction schedule congruent with actual construction activity as scheduled. These updates are for the Architect to confirm construction activities are on schedule.
 4. Recovery Schedule: In the event of significant schedule slippage, as determined by the Architect, within 48 hours (2 working days) the Contractor shall provide a project recovery schedule indicating how the Work is to be completed to return to the original project schedule.

1.2 RELIANCE UPON SCHEDULE

- A. The construction schedule as approved by the Architect will be an integral part of the contract and will establish conditions for various activities and phases of constructions.

1.3 CONSTRUCTION SCHEDULE

- A. Diagram: Graphically show the order of all activities necessary to complete the work and the sequence in which each activity is to be accomplished. Indicate critical path.
- B. In addition to project construction, activities shown on the diagram shall include but not necessarily be limited to:
1. Project mobilization
 2. Submittals and approvals of shop drawings and samples
 3. Phasing of construction
 4. Procurement of equipment and critical materials
 5. Fabrication and installation of special material and equipment
 6. Final clean-up
 7. Final inspection and testing
- C. The construction schedule shall be maintained and current at all times and shall be submitted with each Application for Payment.
- D. Provide a current “three week look ahead” based on the overall project schedule at each project meeting.

1.4 CONSTRUCTION SCHEDULE LIMITATIONS

- A. A. Work performed under this Contract shall be done in accordance with the following paragraphs:
1. All work may proceed immediately upon Notice to Proceed and continue uninterrupted.

2. Under the Base Proposal only, the successful Offeror will be 1) entitled to certain extensions of time and 2) subject to liquidated damages for work not completed beyond the agreed date which the Contractor shall require for Substantial Completion of the work included in this contract. Refer to Supplementary Conditions for additional requirements and liquidated damages.
3. Failure to complete and close-out project after substantial completion may result in liquidated damages. Refer to Supplementary Conditions for additional requirements and liquidated damages.
4. Certificate of Substantial Completion will be issued for any of the above mentioned areas of work which are complete prior to the completion of the entire project.
5. The Owner may at his discretion approve changes recommended by the successful Offeror to the above-mentioned schedule provided that the Owner's use of newly completed areas are not disrupted.

PART 2 - PRODUCTS

A. Not Used

PART 3 - EXECUTION

A. Not Used

END OF SECTION 01 32 16

SECTION 01 33 00 – SUBMITTAL PROCEDURES

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

PART 1 - GENERAL

1.1 SUBMITTAL PROCEDURES

- A. Transmit to the Architect/Engineer each item indicated in individual specification sections with approved form identifying:
 - 1. Date of submission and dates of any previous submissions.
 - 2. Project title and number
 - 3. Contract identification
 - 4. Names of Contractor, Supplier, Manufacturer
 - 5. Pertinent drawing sheet and detail number, and specification section number, as appropriate
 - 6. Deviations from Contract Documents.
- B. Contractor shall be responsible for initial review prior to submittal to Architect/Engineer to verify adequacy and conformance to contract requirements. Lack of review by Contractor shall be grounds for rejection.
- C. Apply Contractor's stamp, signed, to each item submitted, certifying that review and verification of products, field dimensions, adjacent construction work and coordination of information is in accordance with the requirements of the work and Contract Documents.
- D. Transmit each item in accordance with approved schedule, and in such sequence as to cause no delay in the work or in the work of any other contractor. Allow minimum of ten (10) days for adequate Architect/Engineer/Owner review of each submittal. Time may vary according to scope and complexity of item under review. Allow adequate time in schedule for revisions and resubmittal as deemed necessary.
- E. Submit one (1) electronic copy to the Architect for review distribution to Consultants. The Architect and Consultant will mark up the electronic copy and return to the Contractor upon completion of review. It will be the Contractor's responsibility to distribute the necessary quantity of copies of the reviewed submittal to all concerned parties.
- F. Submit each item according to individual specification sections and identified by Division, Section, and individual submittal number. Maintain log according to each Division.
- G. Revise and resubmit submittal as required; identify all changes made since previous submittal.
 - 1. Make any corrections or changes in the submittals required by the Architect/Engineer and resubmit until approved.
 - 2. Submit new submittal as required for initial submittal.

1.2 PROPOSED PRODUCTS LIST

- A. Within 30 days after date of Notice to Proceed, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
- B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.3 PRODUCT DATA

- A. Submit to Architect for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

- B. Submit the electronic copies of product data for Architect review and submit physical samples of any material needing to be selected.
- C. Mark submittal to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project

1.4 MSDS SHEETS

- A. The Texas Asbestos Health Protection Rules (Title 25. Health Services, Part I. Texas Department of Health Chapter 295 - Occupational Health, Subchapter C - Texas Asbestos Health Protection) were approved and became effective on October 20, 1992, and amended March 27, 2003. The Rules established the procedures and means to implement the provisions of Senate Bill 1341 and House Bill 79.
- B. Pursuant to the above referenced Rules, submit MSDS Sheets showing that materials used in the Project, contain 1.0 percent or less asbestos. This requirement pertains to every material in every Section of the Specifications, as applicable to the Project, whether written therein, or not. Submit MSDS Sheets for materials, including, but not limited to the following, as applicable to the Project.
 - 1. Surfacing Materials:
 - a. acoustical plaster;
 - b. decorative plaster/stucco;
 - c. textured paint/coating;
 - d. spray applied insulation;
 - e. blown-in insulation
 - f. fire proofing insulation;
 - g. joint compound; and
 - h. spackling compounds
 - 2. Thermal System Insulation:
 - a. taping compounds (thermal)
 - b. HVAC duct insulation;
 - c. boiler insulation;
 - d. breaching insulation;
 - e. pipe insulation; and
 - f. thermal paper products
 - 3. Miscellaneous Material:
 - a. cement wallboard/siding;
 - b. asphalt/vinyl floor tile
 - c. vinyl sheet flooring/vinyl wall coverings;
 - d. floor backing;
 - e. construction mastic;
 - f. ceiling tiles/lay-in ceiling panels;
 - g. packing materials;
 - h. h. high temperature gaskets;
 - i. laboratory hoods/table tops
 - j. fire blankets/curtains;
 - k. elevator equipment panels;
 - l. elevator brake shoes;
 - m. ductwork flexible fabric connections;
 - n. cooling towers;
 - o. heating and electrical ducts;
 - p. electrical panel partitions;
 - q. electrical cloth/electrical wiring insulation;

- r. chalkboards;
- s. roofing shingles/tiles;
- t. roofing felt;
- u. base flashing;
- v. fire doors;
- w. caulking/putties;
- x. adhesives/mastics; and
- y. wallboard

1.5 SHOP DRAWINGS

- A. Submit to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.
- B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. Submit electronic copy of the shop drawing for the Architect to review.
- D. All dimensions indicated on the drawings are based on the specific models and manufacturers of products, equipment, fixtures and miscellaneous items specified. If the Contractor uses an approved product by another listed manufacturer which is different than the specific model and manufacturer listed in these specifications, then the Contractor shall be solely responsible for the coordination of any dimensional changes required, including structural, relocation of walls, equipment, fixtures, ceilings and miscellaneous items. When dimensional changes are required in these situations, the Contractor shall submit a proposed modification drawing to the Architect for approval prior to proceeding with the work. All causes and effects of the dimensional change shall be indicated on the Contractor's drawing submittal.

1.6 SAMPLES

- A. Submit for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.
- B. Submit for aesthetic, color, or finish selection. Where a color or finish is not identified in the drawings submit physical samples of full range of manufacture's standard colors, textures, and patterns for Architect's selection.
- C. Submit samples to illustrate functional characteristics of the Product, with integral parts and attachment devices. Coordinate submittal of different categories for interfacing work.
- D. Submit the number specified in respective Specification Section; minimum of two (2), of which one (1) will be retained by Architect.
- E. Reviewed samples which may be used in the Work are indicated in individual specification sections.
- F. Samples will not be used for testing purposes unless specifically stated in specification section.

1.7 DESIGN DATA

- A. When required, submit for Architect/Engineer's knowledge as contract administrator or for Owner.
- B. Submit design data for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.8 TEST REPORTS

- A. In accordance with Section 01 45 23, Testing and Inspecting Services, submit test reports for Architect/Engineer's knowledge as contract administrator or for Owner. Architect will determine whether corrective action is required.
- B. Submit test reports for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.9 CERTIFICATES

- A. When specified in individual specification sections, submit certification by manufacturer, installation/application subcontractor, or Contractor to Architect, in quantities specified.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect and Owner.
- D. Submit required certificates in duplicate.

1.10 GUARANTEES

- A. When specified in individual specification sections, submit warranties by manufacturer, installation/application subcontractor, fabricator, or Contractor to Architect, in quantities specified.
- B. Submit warranties in accordance with Section 01 77 00, Project Closeout.

1.11 MANUFACTURER'S INSTRUCTIONS

- A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to Architect for delivery to Owner in quantities specified.
- B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- C. Submit required instructions in duplicate.

1.12 MANUFACTURER'S FIELD REPORTS

- A. Submit reports for Architect/Engineer's benefit as contract administrator or for Owner.
- B. Submit report in quantity specified or required within ten (10) days of observation to Architect for information. Architect will determine whether corrective action is required.
- C. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.13 ERECTION DRAWINGS

- A. When required, submit drawings for Architect/Engineer's benefit or for Owner.
- B. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.
- C. Data indicating inappropriate or unacceptable Work may be subject to action by Architect/Engineer or Owner. Architect will determine whether corrective action is required.

1.14 COORDINATION DRAWINGS

- A. Areas where multiple trades and disciplines have concurrent or sequenced work, the Contractor shall submit coordination drawings indicating coordination of the work among all trades to reduce conflicts. All coordination, review and approval shall be complete prior to the beginning of installation of any work in these areas. Failure to coordinate work in these areas shall be grounds for disapproval of any requests for change orders, substitution requests, alternate means to achieve desired result or schedule modifications. Areas include, but are not limited to, above ceilings in corridors, chase walls, and any other condition where sequencing and conflicts among trades may arise.

PART 2 - PRODUCTS

- A. Not Used

PART 3 - EXECUTION

- A. Not Used

END OF SECTION 01 33 00

SECTION 01 41 00 - TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections apply to work specified in this Section.

1.2 PROCEDURE

A. Testing Laboratory:

An independent testing laboratory will be selected and furnished by the Owner to inspect and test the materials and methods of construction as hereinafter specified for compliance with the specification requirements of the Contract Documents and to perform such other specialized technical services as required by the Owner or his representative. All testing lab services shall be paid for by the owner.

1.3 QUALIFICATIONS OF TESTING LABORATORY

- A.** The Testing Laboratory selected shall meet the basic requirements of ASTM E329 "Standard of Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction", and shall submit to the Contractor, Owner, Architect, and Engineer, a copy of the report of inspection of their facilities made by the Materials Reference Laboratory of the National Bureau of Standards during the most recent tour of such inspections, and shall submit a memorandum stating steps taken to remedy all deficiencies reported by this inspection.
- B.** The Testing Laboratory selected shall meet "Recommended Requirements for Independent Laboratory Qualification", latest edition, as published by the American Council of Independent Laboratories.
- C.** The Testing Laboratory shall be approved by the local Building Official to perform inspection and certification services as an approved inspector of prefabricated construction.
- D.** Testing machines shall be calibrated at intervals not exceeding 12 months by devices of accuracy traceable to the National Bureau of Standards or accepted values of natural physical constants. The Testing Laboratory shall submit a copy of certificate of calibration made by an accredited calibration agency.
- E.** Tests and inspections shall be conducted in accordance with specified requirements, and if not specified, in accordance with the applicable standards of the American Society for Testing and Materials or other recognized and accepted authorities in the field.

1.4 AUTHORITIES AND DUTIES OF THE LABORATORY

A. Attending Preconstruction Conferences:

The Testing Laboratory shall obtain and review the project plans and specifications with the Architect and Engineer as soon as possible prior to the start of construction. The Laboratory shall attend preconstruction conferences with the Architect, Engineer, Project Manager, General Contractor, and Material Suppliers as required to coordinate materials inspection and testing requirements with the planned construction schedule. The Laboratory will participate in such conferences throughout the course of the project.

B. Outline Testing Program:

The Testing Laboratory shall be responsible for outlining a written detailed testing program conforming to the requirements as specified in the Contract Documents and in consultation with the Owner, Contractor, Architect, and Engineer. The testing program shall contain an outline of inspections and tests to be performed with reference to applicable sections of the specifications or drawings and a list of personnel assigned to each portion of the work. Such testing program shall be submitted to the Owner, Contractor, Architect, and Engineer five weeks in advance of the start of construction so as not to delay the start of construction. It shall be the Testing Laboratory's responsibility that such program conforms to the requirements of the Specifications and drawings and falls within the budget for testing laboratory services. If the allocated budget is not sufficient to cover the services as outlined in the Specifications, it shall be the responsibility of the Laboratory to notify the Contractor, Architect, Engineer, and Owner so that the Laboratory services can be modified accordingly prior to the start of construction. Furthermore, the Testing Laboratory shall monitor its expenditures throughout the course of the job and notify immediately the Owner, Contractor, Architect, and Engineer, of any significant deviation from the planned testing program and budget.

C. Cost Proposal:

The Testing Laboratory's proposal to the Owner shall contain the outlined testing program based on a unit price basis for tests and inspections and on an hourly basis for personnel. A total estimated price shall also be submitted.

D. Cooperation with Design Team:

The Laboratory shall cooperate with the Architect, Engineer, and Contractor and provide qualified personnel promptly on notice.

E. The Laboratory shall perform the required inspections, sampling, and testing of materials as specified under each section and observe methods of construction for compliance with the requirements of the Contract Documents.

F. Inspections Required by Government Agencies:

The Testing Laboratory shall perform all inspections and submit all reports and certifications as required by all government agencies.

G. Notification of Deficiencies in the Work:

The Laboratory shall notify the Architect, Engineer, and Contractor first by telephone and then in writing of observed irregularities and deficiencies of the work and other conditions not in compliance with the requirements of the Contract Documents.

H. Reports:

1. Information on Reports:

The Laboratory shall submit copies of all reports of inspections and tests promptly and directly to the parties named below. All reports shall contain at least the following information:

- a. Project Name
- b. Date report issued
- c. Testing Laboratory name and address
- d. Name and signature of inspector
- e. Date of inspection and sampling
- f. Date of test
- g. Identification of product and Specification section
- h. Location in the project
- i. Identification of inspection or test
- j. Record of weather conditions and temperature (if applicable)
- k. Results of test regarding compliance with Contract Documents.

2. Copies:

The Laboratory shall send certified copies of test and inspection reports to the following parties:

- a. 2 copies to the Owner or his representative
- b. 2 copies to the General Contractor
- c. 1 copy to the Architect
- d. 1 copy to the Engineer of responsibility
- e. 1 copy to the Supplier of the material tested

3. Certification by Notary Public:

Upon completion of the job, the Testing Laboratory shall furnish to the Owner, Architect, and Engineer of responsibility, a statement certified by a Notary Public that all required tests and inspections were made in accordance with the requirements of the Contract Documents.

I. Accounting:

The Testing Laboratory shall be responsible for separating and billing costs attributed to the Owner and cost attributed to the Contractor.

J. Obtaining Product and Material Certifications:

The Testing Laboratory shall be responsible for obtaining all product and material certifications from manufacturers and suppliers as specified in the Specifications.

K. Limitations of Authority:

The Testing Laboratory is not authorized to revoke, alter, relax, enlarge upon, or release any requirements of the Specifications or to approve or accept any portion of the work or to perform any duties of the General Contractor and his Subcontractors.

1.5 CONTRACTORS RESPONSIBILITY

A. Cooperation with Design Team:

The owner shall pay for all testing lab services. The Contractor shall cooperate with laboratory personnel, provide access to the work, and to manufacturers operations.

B. Furnishing Samples:

The Contractor shall provide to the laboratory representative, samples of materials proposed for use in the work in quantities sufficient for accurate testing as specified.

C. Furnishing Casual Labor, Equipment and Facilities:

The Contractor shall furnish casual labor, equipment, and facilities as required for sampling and testing by the Laboratory and otherwise facilitate all required inspections and tests.

D. Advance Notice:

The Contractor shall be responsible for notifying the Testing Laboratory sufficiently in advance of operations to allow for assignment of personnel and scheduling of tests.

E. Payment for Substitution Testing:

The Contractor shall arrange with the Testing Laboratory and pay for any additional samples and tests above those required by the Contract Documents as requested by the Contractor for his convenience in performing the work.

F. Payment for Retesting:

The Contractor shall pay for any additional inspections, sampling, testing, and retesting as required when initial tests indicate work does not comply with the requirements of the Contract Documents.

G. Payment by Contractor:

The Contractor shall furnish and pay for the following items:

1. Soil survey of the locations of borrow soil materials, samples of existing soil materials, and delivery to the Testing Laboratory.
2. Samples of concrete aggregates and delivery to the Testing Laboratory.
3. Concrete mix designs as prepared by his concrete supplier or by his Testing Laboratory.
4. Concrete coring, tests of below strength concrete, and load tests, if ordered by the Owner, Architect, or Engineer.
5. Certification of reinforcing steel mill order.
6. Certification of structural steel mill order.
7. Certification of Portland cement, lime, and flyash.
8. Certification of welders.
9. Tests, samples and mock-ups of substitute material where the substitution is requested by the Contractor and the tests are necessary in the opinion of the Owner, Architect, or Engineer to establish equality with specified items.
10. Any other tests when such cost are required by the Contract Documents to be paid by the Contractor.

H. Notification of Source Change:

The Contractor shall be responsible for notifying the Owner, Architect, Engineer, and Testing Laboratory when the source of any material is changed after the original tests or inspections have been made.

I. Tests for Suspected Deficient Work:

If in the opinion of the Owner, Architect, or Engineer any of the work of the Contractor is not satisfactory, the Contractor shall make all tests that the Owner,

Architect, or Engineer deem advisable to determine its proper construction. The owner shall pay all costs if the tests prove the questioned work to be satisfactory.

1.6 PAYMENT OF TESTING LABORATORY

The Owner will pay for all Laboratory services for testing of materials for compliance with the requirements of the Contract Documents. The Contractor will pay for testing and retesting of materials that do not comply with the requirements of the Contract Documents and all other items as specified in these Specifications.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCOPE OF WORK

The work to be performed by the Testing Laboratory shall be as specified in this Section of the Specification and the contract drawings, and as determined in meetings with the Contractor, Owner, Architect, and Engineer.

3.2 EARTHWORK

A. Tests of Proposed Fill Material:

The Testing Laboratory shall conduct a survey of the Contractor's proposed location of borrow soil materials and shall establish the suitability of any proposed fill material by determining the required engineering properties. Soil tests shall include soil classification by the Atterberg Limit Tests ASTM D4138, and grain size determined by ASTM D422 "Particle Size Analysis of Soils" unless noted otherwise in the geotechnical investigation reports.

B. Moisture Density Relationship for Natural and Fill Materials:

The Testing Laboratory shall provide one optimum moisture density curve for each type of soil, natural, imported fill, or on-site fill, encountered in subgrade and fills under building slabs and paved areas. Curves shall be generated in accordance with ASTM D1557 "Test Methods for Moisture Density Relationships of Soils and Soil Aggregate Mixtures" unless noted otherwise in the geotechnical investigation report.

C. Quality Control Testing Required During Construction:

1. Inspection of Subgrade and Fill:

The Owner's Testing Laboratory shall inspect and approve the following subgrades and fill layers before further construction work is performed thereon:

- a. Paved Areas: Make at least one field density test of the natural subgrade for every 2500 square feet of paved area or slab but in no case less than three tests. In each compacted fill layer or lift, make one field density test for every 2500 square feet of slab or paved area but in no case less than three tests.

2. Field Density Tests:

Field Density Tests shall be run according to ASTM D1556 "Density of Soil in Place by the Sand Cone Method," ASTM D2167 "Density of Soil in Place by the Rubber Balloon Method" or ASTM D2922 "Density of Soil and Soil Aggregate in Place by Nuclear Methods" or ASTM D698 "Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort" as applicable unless noted otherwise in the geotechnical investigation reports.

3. Acceptance Criteria:

The result of field density tests by the Testing Laboratory will be considered satisfactory if the average of any three consecutive tests has a value not greater than 2 percent below the required density.

4. Report Copies:

The Testing Laboratory shall submit all moisture density curves and results of field density tests to the parties specified earlier in this section.

5. Additional Testing:

If reports by the Testing Laboratory indicate field densities lower than specified above, additional tests will be run by the Testing Laboratory with at least the frequencies scheduled above on recompacted fill and/or natural subgrade. The Testing Laboratory shall notify the Contractor on a timely basis for any required retesting so as not to delay the work. The costs of such tests shall be borne by the Contractor.

3.3 REINFORCING STEEL

A. Visual Inspection:

The Testing Laboratory shall inspect the rebar to determine the following:

1. The bars shall be free from injurious defects and shall have a workman-like finish.
2. Deformations shall be of the proper sizes, shapes, and spacing as detailed in ASTM A-615.
3. The bars shall not have excessive rust and/or pelting.

4. The bars shall not have any unusual twists or bends.
- B. Identified Stock:

Where job material is taken from bundles as delivered from the mill, is properly identified as to heat number and is accompanied by mill and analysis test reports, provided an affidavit is given from the Supplier to the Testing Laboratory that the materials conform with the requirements of the ASTM specification as listed on the structural drawings. In case of controversy, the procedure as stipulated below for unidentified stock shall be followed.

- C. Unidentified Stock:

For all unidentified stock, the Testing Laboratory shall secure samples of the reinforcing steel bars at the time of inspection. The samples shall confirm to the following:

1. The sample shall include 2 bars for each ten tons or fraction thereof, of each bar size, heat number, and manufacturer being shipped.
2. The sample bars shall be a minimum of 24 inches in length and should be identical to the material being shipped.

The Testing Laboratory shall tag each of the steel bundles with the Laboratory identification tag and appropriately mark the samples corresponding to the steel being inspected and shipped. The fabricator will supply shipping lists showing the weight of each bar size in the shipment.

3.4 CONCRETE MATERIALS AND POURED IN PLACE CONCRETE

- A. Tests of Portland Cement:

Portland Cement shall be tested by the Testing Laboratory for compliance with the requirements of ASTM C150.

1. Mill Certificates:

Mill certificates certifying that the cement has been tested and meets the requirements of the Specifications will be acceptable as test results, provided the cement proposed for use can be identified with test lots. Mill certificates shall be submitted by the Contractor prior to use of any such material.

2. Retesting:

Retesting of cement will be required if:

- a. In the opinion of the Owner, Architect, or Engineer, the cement has been damaged in storage or transit or is any way defective.
- b. The cement has been in storage at the mixing site for over 30 days.

B. Test of Aggregates:

1. The Contractor's Testing Laboratory shall verify that concrete aggregates proposed for use conform to the following specification:
 - a. ASTM C33 "Specification for Concrete Aggregates"

Suppliers record of tests run on the proposed materials will be adequate provided a written affidavit is furnished as a shop drawing submittal.

C. Concrete Mix Designs:

The Contractor shall submit for approval by the Engineer and Testing Laboratory at least 15 days prior to the start of construction, concrete mix designs for each class of concrete indicated on the structural drawings and in the Specifications. The Contractor shall not begin work until the applicable mix design has been approved.

1. The Contractor acting in conjunction with his Concrete Supplier and the Testing Laboratory shall submit in writing with his mix designs, whether the concrete is to be proportioned by either of the following methods as outlined in ACI 318:
 - a. Field Experience Method
 - b. Laboratory Trial Batch Method

When field experience methods are used to select concrete proportions, establish proportions as specified in ACI 301 and ACI 211. When Laboratory trial batches are used to select concrete proportions, the procedure as outlined in ACI 318 shall be followed. Prepare test specimens in accordance with ASTM C192 and conduct strength tests in accordance with ASTM C39.

2. Required types of concrete and compressive strengths shall be as indicated on the Structural Drawings and as specified in the various sections of the Specifications.
3. All mix designs shall state the following information:
 - a. Mix design number or code designation by which the Contractor shall order the concrete from the Supplier
 - b. Structural member for which the concrete is designed (i.e. columns, piers, etc.)

- c. Type of concrete (normal weight).
- d. 28 day compressive strength
- e. Aggregate type, source, size, gradation, fineness modulus
- f. Cement type and brand
- g. Fly ash type and brand (if any)
- h. Admixtures including air entrainment, water reducers, accelerators, and retarders
- i. Slump
- j. Proportions of each material used
- k. Water cement ratio and maximum allowable water content
- l. Method by which the concrete is intended to be placed (bucket, chute, or pump)

4. Concrete Suppliers Record of Quality Control:

The concrete supplier's past record of quality control shall be used in the design of the concrete mixes to determine the amount by which the average concrete strength $f'c$ should exceed the specified strength $f'c$ as outlined in ACI 318. If a suitable record of test results is not available, the average strength must exceed the design strength by 1200 PSI as specified in ACI 318. After sufficient data becomes available from the job, the statistical methods of ACI 214 may be used to reduce the amount by which the average strength must exceed $f'c$ as outlined in ACI 318.

5. Admixtures:

- a. Admixtures to be used in concrete shall be subject to the approval of the Engineer and Testing Laboratory.
- b. Quantities of admixtures to be used shall be in strict accordance with the manufacturers instructions.
- c. Admixtures containing chloride ions shall not be used in concrete containing galvanized or aluminum embedments.
- d. Air entraining admixtures shall conform to "Specification for Air Entraining Admixtures for Concrete" ASTM C260.
- e. Water reducing admixtures, retarding admixtures, accelerating admixtures, water reducing and retarding admixtures, and water reducing and accelerating admixtures shall conform to "Specification for Chemical Admixtures for Concrete" ASTM C494.
- f. Fly ash or other pozzolons, used as admixtures, shall conform to "Specification for Fly Ash and Raw or Calcined Natural Pozzolons for use in Portland Cement Concrete" ASTM C618. Obtain mill test reports for approval. Maximum flyash content shall be 20%.

- g. Use amounts of admixtures as recommended by the manufacturer for climatic conditions prevailing at the time of placing. Adjust quantities of admixtures as required to maintain quality control.

6. Slump Limits:

Unless shown otherwise on the structural drawings, proportion and design mixes to result in concrete slump at the point of placement as follows:

- a. Ramps and Sloping surfaces - $3" \pm 1"$
- b. Foundation concrete - $4-1/2" \pm 1-1/2"$
- c. All other concrete - $4" \pm 1"$

When increased workability, pumpability, lower water-cement ratio, shrinkage reduction, or permeability reduction is required, then a superplasticizer admixture shall be considered for use. The maximum slump with the use of superplasticizers shall be 8 inches unless approved otherwise by the Architect/Engineer and Testing Laboratory.

Any deviation from these values (such as concrete design to be pumped) shall be submitted to the Engineer and Testing Laboratory for approval.

7. Adjustments of Concrete Mixes:

Mix design adjustments may be requested by the Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant. Such mix design adjustments shall be provided at no additional cost to the Owner. Any adjustments in approved mix designs including changes in admixtures shall be submitted in writing to the Engineer and Testing Laboratory for approval prior to field use.

8. Shrinkage:

All concrete shall be proportioned for a maximum allowable unit shrinkage of 0.03% at 28 days as determined by ASTM C 157.

9. Chloride Ion Content:

A written submittal shall be made with each mix design proposed for use on the project that the chloride ion content from all ingredients including admixtures will not exceed the limits specified in the Cast-In-Place section of the Specifications.

D. Concrete Test Cylinders by the Testing Laboratory:

1. Molding and Testing:

Cylinders for strength tests shall be molded and Laboratory cured in accordance with ASTM C31 "Method of Making and Curing Concrete Test

Cylinders in the Field" and tested in accordance with ASTM C39 "Method of Testing for Compressive Strength of Cylindrical Concrete Specimens".

2. Field Samples:

Field samples for strength tests shall be taken in accordance with ASTM C172 "Method of Sampling Fresh Concrete".

3. Frequency of Testing:

Each set of test cylinders shall consist of a minimum of four standard test cylinders. A set of test cylinders shall be made according to the following frequency guidelines:

- a. One set for each class of concrete taken not less than once a day.
- b. Mat Foundation: One set for each 250 cubic yards or fraction thereof.
- c. All Other Concrete: A minimum of one set for each 150 cubic yards or fraction thereof.
- d. No more than one set of cylinders at a time shall be made from any single truck.
- e. If the total volume of concrete is such that the frequency of testing as specified above would provide less than five strength tests for a given class of concrete, tests shall be made from at least five randomly selected batches or from each batch if fewer than five batches are used.
- f. Frequencies assume one batch plant will be used for each pour. If more than one batch plant is used, the frequencies cited above shall apply for each plant used.

The cylinders shall be numbered, dated, and the point of concrete placement in the building recorded. Of the four cylinders per set break one at seven days, two at 28 days, and one automatically at 56 days only if either 28 day cylinder break is below required strength.

4. Cylinder Storage Box:

The Contractor shall be responsible for providing a protected concrete cylinder storage box at a point on the jobsite mutually agreeable with the Testing Laboratory for the purpose of storing concrete cylinders until they are transported to the Laboratory.

5. Transporting Cylinders:

The Testing Laboratory shall be responsible for transporting the cylinders to the Laboratory in a protected environment such that no damage or ill effect will occur to the concrete cylinders.

6. Information on Concrete Test Reports:

The Testing Laboratory shall make and distribute concrete test reports after each job cylinder is broken. Such reports shall contain the following information:

- a. Truck number and ticket number
- b. Concrete Batch Plant
- c. Mix design number
- d. Accurate location of pour in the structure
- e. Strength requirement
- f. Date cylinders made and broken
- g. Technician making cylinders
- h. Concrete temperature at placing
- i. Air temperature at point of placement in the structure
- j. Amount of water added to the truck at the batch plant and at the site and whether it exceeds the amount allowed by the mix design
- k. Slump
- l. Unit weight
- m. Air content
- n. Cylinder compressive strengths with type of failure if concrete does not meet Specification requirements. Seven day breaks are to be flagged if they are less than 60% of the required 28 day strength. 28 day breaks are to be flagged if either cylinder fails to meet Specification requirements.

E. Other Required Tests of Concrete by the Testing Laboratory (unless noted otherwise):

1. Slump Tests:
Slump Tests (ASTM C143) shall be made at the beginning of concrete placement for each batch plant and for each set of test cylinders made.
2. Air Entrainment:
Air entrainment (ASTM C233) tests shall be made at the same time slump tests are made as cited above.
3. Concrete Temperature:
Concrete temperature at placement shall be measured at the same time slump tests are made as cited above.
4. Chloride Ions:

The Contractor shall have the laboratory verify in a written submittal with the mix designs that the chloride ion concentration will not exceed the limits specified.

Tests shall be run for each class of concrete according to AASHTO Designation T 260-82 Sampling and Testing for Total Chloride Ion in

Concrete and Concrete Raw Materials to determine that the maximum chloride ion content does not exceed the limits stated in the concrete section of the specifications. One test shall be run for each set of cylinders specified to be taken for each class of concrete.

F. Evaluation and Acceptance of Concrete:

1. Strength Test:

A strength test shall be defined as the average strength of two 28 day cylinder breaks from each set of cylinders.

2. Quality Control Charts and Logs:

The Testing Laboratory shall keep the following quality control logs and charts for each class of concrete containing more than 2,000 cubic yards. The records shall be kept for each batch plant and submitted on a weekly basis with cylinder test reports:

- a. Number of 28 day strength tests made to date.
- b. 28 day strength test results containing the average of all strength tests to date, the high test result, the low test result, the standard deviation, and the coefficient of variation.
- c. Number of tests under specified 28 day strength.
- d. A histogram plotting the number of 28 day cylinders versus compressive strength.
- e. Quality control chart plotting compressive strength test results for each test.
- f. Quality control chart plotting moving average for strength where each point plotted is the average strength of three previous test results.
- g. Quality control chart plotting moving average for range where each point plotted is the average of 10 previous ranges.

3. Acceptance Criteria:

The strength level of an individual class of concrete shall be considered satisfactory if both of the following requirements are met:

- a. The average of all sets of three consecutive strength tests equal or exceed the required f'_c .
- b. No individual strength test (average of two 28 day cylinder breaks) falls below the required f'_c by more than 500 PSI.

If either of the above requirements is not met, the Testing Laboratory shall immediately notify the Engineer by telephone. Steps shall immediately be taken to increase the average of subsequent strength tests.

G. Investigation of Low Strength Concrete Test Results:

1. Contractor Responsibility for Low Strength Concrete:

If any strength test of Laboratory cured cylinders falls below the required f'_c by more than 500 psi, the Contractor shall take steps immediately to assure that the load carrying capacity of the structure is not jeopardized.

2. Nondestructive Field Tests:

The Testing Laboratory shall under the direction of the Engineer perform nondestructive field tests of the concrete in question using Swiss Hammer, Windsor Probe, or other appropriate methods as approved by the Engineer and report the results in the same manner as for cylinder test reports.

3. Core Tests:

If the likelihood of low strength concrete is confirmed and computations indicate that the load carrying capacity of the structure has been significantly reduced, tests of cores by the Testing Laboratory, drilled from the area in question under the direction of the Engineer, will be required in accordance with ASTM C42 "Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete". In such case, three cores shall be taken for each strength test more than 500 PSI below required f'_c . If concrete in the structure will be dry under service conditions, cores shall be air dried (temperature 60° to 80°F, relative humidity less than 60 percent) for 7 days before test and shall be tested dry. If concrete in the structure will be more than superficially wet under service conditions, cores shall be immersed in water for at least 48 hours and tested wet. The Contractor shall fill all holes made by drilling cores with an approved drypack concrete.

4. Acceptance Criteria for Core Tests:

Concrete in an area represented by core tests shall be considered structurally adequate if the average of three cores is equal to at least 85% of f'_c and if no single core is less than 75% of f'_c . If approved by the Engineer, locations of erratic core strengths may be retested to check testing accuracy.

5. Load Test:

If the above criteria are not met and the structural adequacy remains in doubt, the Engineer may order a load test as specified in ACI 318 for the questionable portion of the structure.

6. Strengthening of the Structure or Demolition:

If the structural adequacy of the affected portion of the structure remains in doubt, the Engineer may order the structure to be strengthened by an appropriate means or demolished and rebuilt.

7. Cost of Investigations for Low Strength Concrete:

The costs of all investigations of low strength concrete shall be borne by the Contractor.

H. Jobsite Inspection:

The scope of the work to be performed by the inspector on the jobsite shall be as follows:

1. Verify that air temperatures at the point of placement in the structure are within acceptable limits defined above prior to ordering of concrete by the Contractor.
2. Inspect concrete upon arrival to verify that the proper concrete mix number, type of concrete, and concrete strength is being placed at the proper location.
3. Inspect plastic concrete upon arrival at the jobsite to verify proper batching. Observe mix consistency and adding of water as required to achieve target slumps in mix designs. Record the amount of water added and note if it exceeds that allowed in the mix design. The responsibility for adding water to trucks at the jobsite shall rest only with the Contractor's designated representative. The Contractor is responsible that all concrete placed in the field is in conformance to the Contract Documents.
4. Obtain concrete test cylinders.
5. Perform slump tests and air entrainment tests.
6. Record information for concrete test reports.
7. Verify that all concrete being placed meets job Specifications. Report concrete not meeting the specified requirements and immediately notify the Contractor, Batch Plant Inspector, Contractor, Architect, Engineer, and Owner.
8. Pick up and transport to Laboratory, cylinders cast the previous day.
9. Check concrete placing techniques to determine that concrete deposited is uniform and that vertical drop does not exceed six feet.
10. The jobsite inspector shall report any irregularities that occur in the concrete at the jobsite or test results to the Contractor, Architect, Owner, and Engineer.

I. Causes for Rejection of Concrete:

The Contractor shall reject all concrete delivered to the site for any of the following reasons:

1. Wrong class of concrete (incorrect mix design number).
2. Air temperature:

Air temperature limits shall be as follows:

- a. Cold Weather: Air temperature must be 40°F and rising
- b. Hot Weather: Air temperature must be cooler than 100°.

Concrete may be placed at other air temperature ranges only with approval of the job inspector for the Testing Laboratory or other duly appointed representative.

3. Concrete with temperatures exceeding 95°F may not be placed in the structure.
4. Air contents outside the limits specified in the mix designs.
5. Slumps outside the limits specified in the mix designs.
6. Excessive Age:
Concrete shall be discharged within 90 minutes of plant departure or before it begins to set if sooner than 90 minutes unless approved by the Laboratory job inspector or other duly appointed representative.

The Contractor is responsible that all concrete placed in the field is in conformance to the Contract Documents.

J. Concrete Batch Trip Tickets:

All concrete batch trip tickets shall be collected and retained by the Contractor. Compressive strength, slump, air, and temperature tests shall be identified by reference to a particular trip ticket. All tickets shall contain the information specified in ASTM C 94. Each ticket shall also show the amount of water that may be added in the field for the entire batch that will not exceed the specified water cement ratio for the design mix. The Contractor and Testing Laboratory shall immediately notify the Architect/Engineer and each other of tickets not meeting the criteria specified.

3.5 STRUCTURAL STEEL

A. Contract Obligations:

1. Owner Responsibility:

The Owner shall pay for all initial field inspections and tests as required during the fabrication and erection of the structural steel.

2. Contractor Responsibility:

The Contractor shall arrange with the Testing Laboratory for the certification of all shop and field welders. Each bolting crew and welder shall be assigned an identifying symbol or mark and all shop and field connections shall be so identified so that the inspector can refer back to the person or crew performing the work. The costs of all retesting of material or workmanship not in conformance with the Contract Documents shall be borne by the Contractor. The Fabricator and Erector shall provide the Laboratory inspector with access to all places where work is being done. A minimum of 24 hours notification shall be given prior to commencement of work. The Contractor shall provide the Testing Laboratory with the following:

- a. A complete set of Architect/Engineer reviewed shop and erection drawings including all revisions and addenda.
- b. Cutting lists, order sheets, material bills, shipping bills, and mill test reports.
- c. Information as to time and place of all rollings and shipment of material to shops.
- d. Representative sample pieces requested for testing.
- e. Full and ample means and assistance for testing all material.
- f. Proper facilities, including scaffolding, temporary work platforms, hoisting facilities, etc., for inspection of the work in the mills, shop and field.

3. Testing Laboratory Responsibility:

Inspection of field work shall be completed promptly so that corrections can be made without delaying the progress of the work. Inspections shall be performed by qualified technicians with a minimum of two years experience in structural steel testing and inspection. All inspection personnel shall be certified in accordance with AWS QC-1. The Testing Laboratory shall provide test reports of all shop and field inspections. Shop test reports shall include shop welders certifications. All test reports shall indicate types and locations of all defects found during inspection, the measures required and performed to correct such defects, statements of final approval of all welding and bolting of shop and field connections, and other fabrication and erection data pertinent to the safe and proper welding and bolting of shop and field connections. In addition to the parties listed in this Specification the Fabricator and Erector shall receive copies of all test reports.

4. Rejection of Material or Workmanship:

The Owner, Architect, Engineer, and Testing Laboratory reserve the right to reject any material or workmanship not in conformance with the

Contract Documents at any time during the progress of the work. However, this provision does not allow waiving the obligation for timely, in sequence inspections.

B. Mill Tests of Structural Steel:

1. Mill Order Steel:

The Fabricator shall furnish certified mill test reports and an affidavit stating that the structural steel furnished meets the requirements of the grade specified on the structural drawings for all mill order steel. In case of controversy, test of the material according to ASTM A6 or A568 as applicable made by the Contractor's Testing Laboratory with certified test reports paid for by the Contractor shall be made to verify conformity with ASTM standards. Tests shall be made for each 10 tons of material used unless approved otherwise by the Engineer.

2. Local Stock Steel:

Materials taken from stock by a Fabricator for use for structural purposes must be of a quality at least equal to that required by the ASTM specifications applicable to the classification covering the intended use. Certified mill test reports shall be accepted as sufficient record of the quality of materials carried in stock by the fabricator provided the stock steel can be identified by heat or melt numbers. In case of controversy, tests by the Contractor's Testing Laboratory with certified reports as specified for mill order steel shall be required.

3. If tests are required, test specimens shall be taken by the Contractor under the direction of the Testing Laboratory and shall be machined by the Testing Laboratory to dimensions as required by the applicable ASTM standards.

C. Field Inspections and Tests:

The Testing Laboratory shall provide inspection in the field for a period of time as determined in consultation with the Architect, Owner, and Engineer prior to the start of erection in a timely manner so as to not delay the start of erection. The following tests and inspections shall be made:

1. Obtain the planned erection procedure, and review with the Erectors supervisory personnel.

2. Verify field welding procedures and obtain welder certificates. (Including welding of cold formed framing.)
3. Check steel as received in the field for possible shipping damage, workmanship, and piece marking.
4. Check plumbness and frame alignment as erection progresses.
5. Check joint preparation and fit up, backing strips, and runout plates for welded moment connections and column splices.
6. Check preheating to assure proper temperature, uniformity, and thoroughness through the full material thickness.
7. Review welding sequence.
8. Visually inspect all field welding for size, length, and quality.
9. Perform nondestructive examination services for various weldments of field erection determined in consultation with the Structural Engineer prior to the start of erection. The Laboratory shall furnish a qualified technician with the necessary equipment to perform radiographic, ultrasonic, magnetic particle, or dye penetrant inspection as required for the item being tested and other duties as outlined for shop inspection in the previous Section. Unless specified otherwise, check all partial and complete penetration welds in connections of beams, girders, columns, and braces. Check 10% of connections with fillet welds. Visual inspection is required for all welds.
10. Check calibration of impact wrenches used in field bolted connections.
11. Visually inspect the welding of metal deck to the structure.
12. Perform field tests on 10% of completed shear connectors in each beam according to inspection procedures outlined in AWS D1.1

The costs of repairing all defective welds and the costs of retesting by the Testing Laboratory shall be borne by the Contractor. If removal of a backing strip is required by the Testing Laboratory to investigate a suspected weld defect, such cost shall be borne by the Contractor.

3.6 OPEN WEB STEEL JOISTS

A. Scope:

The Testing Laboratory shall perform inspection of open web steel joists in the field as herein described.

B. Obtaining Manufacturer's Product Certification:

The Testing Laboratory shall obtain product certification for open web steel joists as required by the Specifications.

C. Inspection in the Field:

The duties of Field Inspector shall be as follows:

1. Inspect joists for damage during shipment.
2. Verify proper bearing of joist supports.
3. Verify camber requirements of joists arriving in the field.
4. Confirm bridging size and location.
5. Confirm attachment of joists to supports (welding or bolting).
6. Confirm bolting of joists to supports at column lines as required by OSHA requirements.
7. Verify that no joists have been damaged during erection.

END OF SECTION 01 41 00

SECTION 01 45 00 – QUALITY CONTROL

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Quality Assurance: Requirements for material and product quality and control of installation.
- B. Tolerances
- C. References and Standards
- D. Mock-ups
- E. Testing Laboratory Services
- F. Inspection Services
- G. Manufacturers' field services

1.2 RELATED SECTIONS

- A. Section 01 41 00 – Testing Laboratory Service
- B. Section 01 33 00 - Submittal Procedures
- C. Section 02 32 00 - Geotechnical Investigations
- D. The Work of this Section shall be included as a part of all Sections of Work, whether referenced therein or not.

1.3 DESCRIPTION OF REQUIREMENTS

- A. Unless specifically noted otherwise, perform all Work shown, mentioned, or reasonably inferred and comply with all work restrictions.
- B. Many of the requirements specified elsewhere are included herein for reference and convenience. Where a conflict occurs between the Contract Documents, either within themselves or each other, the more stringent requirement or the most expensive combination of materials and workmanship shall prevail.
- C. Contractor shall:
 - 1. perform Work in accordance with the General Conditions, as specified herein, and with the quality control requirements of each Specification Section;
 - 2. perform Work in the highest quality workmanship, unless specified otherwise;
 - 3. join materials with a uniform and accurate fit so they meet with neat straight lines, free of smears, overlaps or irregularities, as applicable to the work;
 - 4. install all exposed materials appropriately level, plumb, and at accurate angles as shown and flush with adjoining materials;
 - 5. attach materials with sufficient strength, and with number and spacing of fasteners and attachments that will not fail until materials joined are broken or permanently deformed;
 - 6. use concealed fasteners, unless shown or directed otherwise.

1.4 QUALITY ASSURANCE AND CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, Products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturer's instructions conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform Work by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.5 TOLERANCES

- A. Monitor fabrication and installation tolerance control of Products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- C. Adjust Products to appropriate dimensions; position before securing Products in place.

1.6 REFERENCES AND STANDARDS

- A. For Products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date of Owner-Contractor Agreement except where specific date is established by code.
- C. Obtain copies of standards where required by product specification sections.
- D. When specified reference standards conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- E. Neither contractual relationships, duties, responsibilities of parties in Contract nor those of Architect/Engineer shall be altered from Contract Documents by mention or inference otherwise in reference documents.

1.7 MOCK-UP REQUIREMENTS

- A. Tests will be performed under provisions identified in this section and identified in respective product specification sections.
- B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- C. Accepted mock-ups shall be the comparison standard for remaining Work.
- D. Where mock-up has been accepted by Architect/Engineer and is specified in product specification sections to be removed; remove mock-up and clear area when directed to do so by Architect.

- E. Mock-up may be approved in phases as portions are completed.
- F. Project Mock-up Requirements: Provide an actual sample panel with the following properties:
 - 1. Building Portion Size: Minimum 10 feet wide by 10 feet high of typical standard building section as determined by Architect. Mock up shall include the construction of wall to include all membrane air barriers, transitions, flashings, standard windows, prefinished aluminum canopy/ louver, etc. used in Project. Size may vary according to specific project requirements. Brace and support as required to withstand structural windloads.
 - 2. Materials: actual exterior finishes including, but not limited to face brick, cast stone, and plaster, actual building materials and assemblies indicating brick patterns on masonry and stud back-up as occurs with dampproofing and flashing as detailed, actual portion of aluminum storefront indicating jam, sill and head attachment and flashing details, and where appropriate, provide mock-up of special finish details, insets and reliefs, reveals, expansion and control joints, brick ledges, brick head and sills, pipe penetrations and waterproofing materials. Provide roof edge flashing and gutter section (as applicable) in pre-finished color as selected by Architect to cap the mock-up panel. Include a sealant joint at least 16 inches long. Brick and stone mock-up panel required in section 04 20 00 Unit Masonry must be approved by Architect prior to mock-up assembly.
 - 3. Drawing: Contractor shall submit mock-up diagram for approval of minimum project requirements.

1.8 TESTING SERVICES

- A. Owner will appoint, employ, and pay for specified services of an independent firm to perform testing.
- B. The independent firm will perform tests and other services specified in individual specification sections and as required by the Architect/Engineer, Owner, or authority having jurisdiction.
- C. Testing and source quality control may occur on or off the project site. Perform off-site testing as required by the Architect/Engineer or the Owner.
- D. Reports will be submitted by the independent firm to the Owner, Architect/Engineer, and Contractor, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.
- E. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
 - 1. Notify Architect/Engineer and independent firm 48 hours prior to expected time for operations requiring services, or as specified in individual specification sections.
 - 2. Make arrangements with independent firm and pay for additional samples and tests required.
- F. Testing does not relieve Contractor to perform Work to contract requirements.
- G. Re-testing required because of non-conformance to specified requirements shall be performed by the same independent firm on instructions by the Architect/Engineer. Payment for re-testing will be charged to the Contractor by deducting testing charges from the Contract Sum/Price.
- H. Refer to Section 01 41 00, Testing Laboratory Services, for additional information concerning testing, and submittal procedures and requirements for Testing Reports.

1.9 INSPECTION SERVICES

- A. Owner will appoint, employ, and pay for specified services of an independent firm to perform inspection.

- B. The independent firm will perform inspections and other services specified in individual specification sections and as required by the Architect/Engineer, Owner, or authority having jurisdiction.
- C. Inspecting may occur on or off the project site. Perform off-site inspecting as required by the Architect/Engineer or the Owner.
- D. Reports will be submitted by the independent firm to the Owner, Architect/Engineer, and Contractor, indicating inspection observations and indicating compliance or non-compliance with Contract Documents.
- E. Cooperate with independent firm; furnish safe access and assistance by incidental labor as requested.
 - 1. Notify Architect/Engineer and independent firm 48 hours prior to expected time for operations requiring services, or as specified in individual specification sections.
- F. Inspecting does not relieve Contractor to perform Work to contract requirements.
- G. Refer to Section 01 41 00, Testing Laboratory Services, for additional information concerning inspections, and submittal procedures and requirements for Inspection Reports.

1.10 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as required, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Architect/Engineer within ten (10) days after receipt of Notice to Proceed, in advance of required observations. Observer subject to approval of Architect/Engineer and Owner.
- C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- D. Refer to Section 01 33 00, Submittal Procedures, for additional information concerning submittal procedures and requirements for Manufacturers Field Reports.

PART 2 - PRODUCTS

- A. Not Used.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Verify existing substrate is capable of structural support or attachment of new Work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Verify utility services are available, of correct characteristics, and in correct locations.

3.2 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.

- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

END OF SECTION 01 45 00

SECTION 01 50 00 – TEMPORARY FACILITIES AND CONSTRUCTION

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

TEMPORARY SERVICES - GENERAL

- A. Provide all temporary services and facilities as specified below, and as required for the proper and expeditious prosecution of the work. Provide all labor, materials, equipment and appliances necessary for the complete installation, operation and maintenance of all temporary service systems and facilities as may be required during work on the project.

UTILITIES

- A. Cost: The Contractor shall provide all temporary electrical and water as may be required to complete work on the project. The Contractor shall be responsible for temporary connection to these utilities and for disconnection from them and returning points of connections to original condition.
- B. Provide temporary electric feeder from electrical service arranged with Utility Company. Complete existing power service capacity and characteristics as required.
- C. Provide power outlets for construction operations with branch wiring and distribution boxes located as required.
- D. Existing water service may be utilized for construction operations at time of project mobilization.
- E. Extend branch piping with outlets located so water is available by hoses with threaded connections.

HEATING, COOLING & LIGHTING

- A. Adequate lighting must be provided throughout the project. Provide and maintain lighting for construction operations.
- B. Provide and maintain lighting to exterior staging and storage areas for security purposes.
- C. Provide heating and cooling devices as needed to maintain specified conditions for construction operations.
- D. The permanent heating and cooling system should be put in operation as soon as possible and shall be used to dry out the building and to provide suitable conditions for finish work.

SANITARY FACILITIES

- A. The Contractor shall provide suitable temporary toilet facilities near the location of the work. Temporary toilets shall be maintained in a sanitary condition at all times and shall be placed in the least obtrusive location available.

STORAGE

- A. Each Contractor shall provide suitable means to protect all stored material subject to damage from the weather.
- B. Contractors may use portions of existing parking lots for storage if approved in advance by Owner. Contractors must protect these areas and return them to their original condition upon completion of the work.

FENCES

- A. Contractors must provide temporary fencing and other barricades to protect stored materials on the site and provide a secure and safe work area around the project.
- B. Coordinate size and location of all fenced storage and work areas with the Owner and Architect prior to erection.
- C. Chain-Link Fencing: Minimum 2-inch, 0.148-inch thick, galvanized steel, chain-link fabric fencing. 6 feet high minimum with galvanized steel pipe posts; minimum 2-3/8-inch OD line posts and 2-7/8-inch OD corner and pull posts, with 1-5/8-inch OD top rails.
 - 1. Securely anchor posts into ground with minimum 30 inch deep, 12 inch diameter concrete filled post holes at 6 feet on center max.
- D. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch thick, galvanized steel, chain-link fabric fencing. 6 feet high minimum with galvanized steel pipe posts; minimum 2-3/8-inch OD line posts and 2-7/8-inch OD corner and pull posts, with 1-5/8-inch OD top rails.
 - 1. Provide concrete, tire or pipe bases for supporting posts.
- E. Provide 6 foot high fence around construction site; equip with locable vehicular gates.

OFFICES

- A. Contractor shall provide his own office on the premises, maintain it, and remove it when directed to by Owner. Contractor shall furnish office space for the Architect as well as for himself.
- B. Coordinate size and location of all offices with the Owner and Architect prior to erection or placement on the premises.

PROTECTION OF PROPERTY & PERSONS

- A. Protect all new or existing walks, curbing, drives, parking lots, planting beds, shrubs, trees and lawn areas. All damage caused by the Contractor or any Subcontractors shall be made good at the expense of the Contractor.
- B. Provide necessary barricades to protect persons entering, leaving or walking around construction areas during the course of the work or during periods when no work is in progress but when conditions around the construction areas could pose a danger.

PROTECTION OF INSTALLED WORK

- A. Protect installed work and provide special protection where required.

- B. Provide temporary and removable protection for installed products. Control construction activity in immediate work area to prevent damage.
- C. Provide protective coverings at walls, projections, jambs, sills and soffits of openings.
- D. Protect finish floors, stairs and other surfaces from traffic, dirt, wear, damage or movement of heavy objects by protecting with durable sheet materials.
- E. Prohibit traffic or storage on waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Prohibit traffic from landscaped areas.

ACCESS ROADS AND PARKING

- A. Construct and maintain temporary roads accessing thoroughfares to serve construction area.
- B. Provide and maintain access to fire hydrants, free off obstructions.
- C. Provide temporary gravel surface parking areas to accommodate construction personnel within the site space.
- D. Do not allow vehicle parking on existing pavement without written approval from school district allowing construction employee parking.

CLEANING AND WASTE REMOVAL

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain project site in a clean and orderly condition.
- B. Remove debris and rubbish from masonry cavities, pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces prior to enclosing the space.
- C. Broom and vacuum clean interior areas daily and prior to start of any interior finish work to eliminate dust.

REMOVAL OF UTILITIES, FACILITIES AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, and materials prior to Substantial Completion.
- B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.
- C. Clean and repair damage caused by installation or use of temporary work.

JOB IDENTIFICATION SIGN

- A. The Contractor shall provide and erect where directed a job sign. Provide 8 feet wide x 4 feet high job sign of exterior grade plywood and wood frame construction, painted, with die cut vinyl, self-adhesive letters and logos to Architect's design and colors.

- B. The sign shall list the names of the Project, the Owner, the Architect, his Consultants, the General Contractor and whichever Subcontractors the General Contractor chooses. Work shall be done by an experienced sign company in a neat and professional manner.
- C. No other signs shall be erected on the job site without permission from the Architect or Owner except those required by law.

END OF SECTION 01 50 00

SECTION 01 60 00 - EXTRA STOCK

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

PART 1 - GENERAL

- 1.1 GENERAL: The Owner is to be provided extra stock of materials under certain sections of the work. These items will be delivered to the Owner's designated storage facility at the end of the project. Applicable items include the following:
- A. SECTION 09 30 00 - TILING: Furnish and deliver to Owner extra materials that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents. Furnish quantity of full-size units equal to 50 SF of amount installed, for each type, composition, color, pattern, and size indicated.
 - B. SECTION 09 51 13 - ACOUSTICAL PANEL CEILINGS: Deliver to the Owner for his use in future modifications, an extra stock of approximately 200 SF of each type of acoustical material installed, packaging each type of material separately, distinctly marked, and adequately protected against deterioration.
 - C. SECTION 09 68 13 – MODULAR FLOORING: Deliver to the Owner for his use in future modifications an extra stock of approximately 72 SF of each color and pattern in each material installed under this Section, packing each type of material separately, distinctly marked, and adequately protected against deterioration.
 - D. SECTION 09 90 00 - PAINTING: Upon completion of the work of this Section, deliver to the Owner an extra stock equaling 2 gallons of each color, type, and gloss of paint used in the work, tightly sealing each container, and clearly labeling with contents and location where used.
 - E. SECTION 09 65 16 – COMMERCIAL VINYL FLOORING: Deliver to the Owner for his use in future modifications an extra stock of approximately 100 SF of each color and pattern in each material installed under this Section, packing each type of material separately, distinctly marked, and adequately protected against deterioration.
 - F. SECTION 09 65 13 – RESILIENT WALL BASE: Deliver to the Owner for his use in future repairs an extra stock of approximately 48'.

PART 2 - PRODUCTS: Not used.

PART 3 - EXECUTION: Not used.

END OF SECTION 01 60 00

SECTION 01 64 00 – OWNER FURNISHED ITEMS

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

SUMMARY

- A. Section Includes:
 - 1. Receive, store (if required), protect, install (if required) and/or coordinate installation of items furnished by Owner.
- B. Related Requirements:
 - 1. Section 01 11 00 – Summary of the Work: Owner Furnished Products.
 - 2. Section 06 10 00 – Rough Carpentry.
 - 4. Section 09 21 16 – Gypsum Board Systems.
 - 5. Section 10 28 13 - Toilet Accessories.
 - 9. Division 23 – Mechanical.
 - 10. Division 26 – Electrical.

QUALITY ASSURANCE

- A. Request copy of manufacturer's product data, shop drawings and installation instructions for each item from Owner.
- B. Install items in strict conformance with manufacturer's instructions.
- C. Coordinate installation and scheduling of items to be installed by third parties contracted to owner.

WARRANTY

- A. Warrant workmanship of installation of Owner furnished/Contractor installed items for a period of one year from the Date of Substantial Completion.

OWNER FURNISHED ITEMS

- A. Stained Glass – Owner Furnished / Third Party Installed.
- B. Bells & Accessories – Owner Furnished / Third Party Installed.
- C. Pews – Owner Furnished / Third Party Installed.
- D. Soap Dispenser – Owner Furnished / Contractor Installed.
- E. Landscaping - Owner Furnished / Third Party Installed.
- F. Irrigation - Owner Furnished / Third Party Installed.
- G. Irrigation Sleeves - Contractor Furnished / Contractor Installed.
- H. Toilet Paper Dispenser – Owner Furnished / Contractor Installed.
- I. Paper Towel Dispenser – Owner Furnished / Contractor Installed.
- J. Stations of the Cross – Owner Furnished / Contractor Installed.
- K. Crucifixes – Owner Furnished / Contractor Installed.
- L. Holy Water Fonts – Owner Furnished / Contractor Installed.
- M. Baptismal Font Shell – Owner Furnished / Third Party Installed.
- N. Masonry Corner Stones (2) - Owner Furnished / Contractor Installed.
- O. Aluminum Cross for Spire - Owner Furnished / Contractor Installed.

CONTRACTOR FURNISHED MATERIALS

- A. Materials required installing Owner furnished items; coordinate with manufacturer's recommendations and installation instructions.

EXAMINATION

- A. Examine Owner furnished items with Owner's representative to ensure that no parts are missing or damaged.

INSTALLATION

- A. Install all items following manufacturer's written instructions.

CLEANING AND ADJUSTING

- A. Clean Owner furnished items after installation using methods and materials recommended by manufacturer.
- B. Adjust all items to ensure smooth operation.

PROTECTION

- A. Protect items from damage by subsequent construction operations.
- B. Repair to Owner's satisfaction, or replace at no cost to Owner, any Owner furnished items that are damaged.

END OF SECTION 01 64 00

SECTION 01 77 00 – PROJECT CLOSEOUT

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

GENERAL

- A. Comply with all requirements of the contract. Send notices, furnish certificates, affidavits and other requirements to complete contract.

SUBSTANTIAL COMPLETION

- A. When entire project (or specified area of the project, if requested by Owner) has reached Substantial Completion as defined in the General Conditions, as may be amended or supplemented, the Contractor shall send written notice and a comprehensive list (a punch list) of items to be completed or corrected to the Architect.
- B. The Architect will then make a preliminary inspection to determine the status of completion and prepare a supplementary list of items requiring completion or correction in addition to Contractor's list for use of the Contractor. This combined list shall constitute the "punch list" for the project.
- C. When all requirements of the General Conditions, as may be amended or supplemented, have been achieved then the Architect will prepare and issue a Certificate of Substantial Completion, AIA Document G 704, to be signed by the Owner and Contractor. This document will be accompanied by a list of any items remaining to be completed on the "punch list" prepared by the Contractor, supplemented by and approved by the Architect.

OPERATIONS INSTRUCTIONS, MANUALS, CERTIFICATIONS & RECORD DRAWINGS

- A. Instruct Owner's representatives in the operation of all mechanical, electrical, plumbing and other building systems as specified. All such instructions shall be coordinated with the Owner's Designated Representative.
- B. Deliver keys to Owner along with typed keying schedules and additional master keys, sub-masters or special keys.
- C. Deliver to the Architect all required written guarantees and warranties prepared and bound in duplicate for his review and delivery to Owner.
- D. Deliver to the Architect all required certificates of inspection prepared and bound in duplicate for his review and delivery to Owner.
- E. Deliver to the Architect all required bound operational manuals for his review and delivery to Owner.
- F. Deliver to the Architect all required hazardous material certifications, **including MSDS sheets**, prepared and bound in duplicate for his review and delivery to Owner.
- G. Deliver to the Architect required Record Drawings for his review and delivery to Owner.

CLOSEOUT LEGAL DOCUMENTS

- A. The following AIA Documents must be completed and delivered to the Architect for review and delivery to the Owner.
1. Contractor's Affidavit of Payment of Debts and Claims, G706, for General Contractor and all major Sub-Contractors and Suppliers.
 2. Consent of Surety Company to Final Payment, G707.
 3. Consent of Surety Company to Reduction in or Partial Release of Retainage, G707A, if necessary.

FINAL INSPECTION

- A. Contractor shall notify the Architect when project is finally complete and all of the above requirements have been met.
- B. Architect will then notify Owner and make a final inspection.

FINAL PAYMENT

- A. Contractor shall submit the final Application and Certificate for Payment to the Architect after elapse of time stipulated in the contract, indicating all contract sum adjustments.
- B. The Architect will approve and deliver to the Owner the final Application and Certificate for Payment upon completion of the final inspection and receipt and approval of all required closeout documentation.

GUARANTEE/WARRANTY INSPECTION

- A. The Contractor shall be required to join the Architect and Owner, if notified to do so, in a walkthrough of the project within 30 days of the expiration of the general one (1) year project guarantee/warranty to determine if any work is still required under the terms of the guarantee/warranty.

END OF SECTION 01 77 00

SECTION 01 78 39 – RECORD DOCUMENTS, AS-BUILT DRAWINGS

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

AS-BUILT DRAWINGS

- A. The Contractor shall provide as-built drawings which clearly show all differences between the contract work as drawn and as actually installed, as well as work added to the contract which is not indicated on the contract drawings.
- B. Special attention should be paid to precisely documenting changes to concealed work, meaning work installed underground or in areas which can not be readily inspected by use of access panels, inspection plates or other removable features.
- C. The Contractor shall maintain a set of record drawings at the job site. These drawings shall be kept legible and current and shall be available for inspection at all times by the Architect.
- D. Upon substantial completion of the work, transfer the changes noted on the record drawings to the as-built drawings.
- E. As-built drawings shall be prepared on full-size paper copies paid for by the Contractor. As-builts shall be provided for all sheets of the drawings.
- F. In showing changes in the work or added work, use the same legends as used on the contract drawings. The as-built drawings shall consist of a (2) complete full-size printed copy. If no changes are made on a particular as-built drawing, a notation reading “No Change” shall be made in the lower right hand corner of the drawing.
- G. As-built drawings shall contain the names, addresses and phone numbers of all the Subcontractors and shall be signed by the Contractor.
- H. Upon completion of the as-built drawings, submit one digital set of as-built drawings to the Architect for approval. Any changes required by the Architect must be made and upon receipt of approval of modified drawings, deliver the as-built printed copy to the owner.
- I. The Architect shall be the sole judge of acceptability of the as-built drawings. Final payment on the project will not be made until the as-built drawings and copies as described above are delivered to and accepted by the Architect.

END OF SECTION 01 78 39

SECTION 02 32 00 – GEOTECHNICAL INVESTIGATION

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

PART 1 - GENERAL

1.1 GENERAL

- A. A copy of the original geotechnical report dated September 25, 2024, is appended to the end of this document as Exhibit-A and is titled as follows:

Intertek PSI
Geotechnical Engineering Report
Holy Rosary Catholic Church
936 FM 2436, La Grange, Texas 78945
PSI Project No. 0312-3058-R2

1.2 REPORT CONTENTS

- A. The information and recommendations contained in the soils report were obtained by the Owner primarily for the use of the Architect and the Structural Engineer in the design and preparation of the Contract Documents for this Project. All bids shall be based on structural design indicated in the drawings and specifications exclusively. Geotechnical report is included for reference only.
- B. The report is not a warranty of subsurface conditions at the Project sites. Should subsurface conditions be found to vary substantially from this report, changes in design and construction foundations will be made, with resulting credits or expenditures to Contract Price/Sum.
- C. Bidders are encouraged to visit the Project site and acquaint themselves with all existing conditions prior to bidding. Bidders may, at their own expense, perform additional subsurface investigations; however, all such investigations must be performed under arrangements approved in advance by the Architect.

1.3 TESTING AND INSPECTIONS

- A. Refer to Section 01 41 00 Testing Lab Services.

END OF SECTION 02 32 00

GEOTECHNICAL ENGINEERING REPORT

**Holy Rosary Catholic Church
936 FM 2436
LaGrange, Texas 78945**

PSI Project No. 0312-3058-R2

PREPARED FOR:

**Queen of Holy Rosary Catholic Church
936 FM 2436
LaGrange, Texas 78945**

September 25, 2024

BY:

**PROFESSIONAL SERVICE INDUSTRIES, INC.
3 Burwood Lane
San Antonio, Texas 78216
Phone: (210) 342-9377**



September 25, 2024

Queen of Holy Rosary Catholic Church
936 FM 2436
LaGrange, Texas 78945

Attn: Reverend Felix Twumasi

RE: GEOTECHNICAL ENGINEERING REPORT
Holy Rosary Catholic Church
936 FM 2436
LaGrange, Texas 78945
PSI Project No. 0312-3058-R2

Dear Father Twumasi:

Professional Service Industries, Inc. (PSI), an Intertek company, is pleased to submit this revised Geotechnical Engineering Report for the referenced project. This revised report includes the results from the field and laboratory investigation along with recommendations for use in preparation of the appropriate design and construction documents for this project.

PSI appreciates the opportunity to provide this revised Geotechnical Engineering Report and looks forward to continuing participation during the design and construction phases of this project. PSI also has great interest in providing materials testing and inspection services during the construction of this project and will be glad to meet with you to further discuss how we can be of assistance as the project advances.

If there are questions pertaining to this report, or if PSI may be of further service, please contact us at your convenience.

Respectfully submitted,

PROFESSIONAL SERVICE INDUSTRIES, INC.

Texas Board of Professional Engineers Certificate of Registration # F003307

Louis Ratcliffe

Louis Ratcliffe, E.I.T.
Project Engineer



Peter Gonzales

Peter Gonzales, P.E.
Geotechnical Department Manager

TABLE OF CONTENTS

Electronic Navigation: The TOC below and [Keywords](#) are hyperlinked to sections of relevance. The  Symbol will return the reader to the TOC.

	Page No.
TABLE OF CONTENTS	I
1.0 PROJECT INFORMATION	1
1.1 PROJECT AUTHORIZATION	1
1.2 PROJECT DESCRIPTION.....	1
1.3 PURPOSE AND SCOPE OF SERVICES	1
2.0 SITE AND SUBSURFACE CONDITIONS	3
2.1 SITE DESCRIPTION	3
2.2 FIELD EXPLORATION	3
2.3 LABORATORY TESTING PROGRAM.....	4
2.4 SITE GEOLOGY.....	4
2.5 SUBSURFACE CONDITIONS	5
3.0 GEOTECHNICAL EVALUATION AND RECOMMENDATIONS	6
3.1 GEOTECHNICAL DISCUSSION.....	6
3.2 POTENTIAL VERTICAL MOVEMENT OF EXPANSIVE SOILS (PVM).....	6
3.3 FOUNDATION RECOMMENDATIONS DISCUSSION	8
3.4 DESIGN MEASURES TO REDUCE CHANGES IN SOIL MOISTURE.....	10
3.5 FOUNDATION DESIGN RECOMMENDATIONS	11
3.6 SIDEWALKS AND FLATWORK.....	20
3.7 SITE SEISMIC DESIGN RECOMMENDATIONS	20
4.0 CONSTRUCTION CONSIDERATIONS	21
4.1 INITIAL SITE PREPARATION CONSIDERATIONS	22
4.2 MOISTURE SENSITIVE SOILS/WEATHER RELATED CONCERNS.....	23
4.3 EXCAVATION OBSERVATIONS	23
4.4 DRAINAGE CONSIDERATIONS.....	23
4.5 EXCAVATIONS AND TRENCHES	23
5.0 REPORT LIMITATIONS	25
APPENDIX	26
Site Vicinity Map	
Boring Location Plan	
Boring Logs	
Key to Terms and Symbols Used on Logs	

INDEX OF FIGURES

	Page No.
Figure 3.1: Reconditioning Method Pad Improvement	9
Figure 3.2: Straight Shaft Drilled Pier	13
Figure 3.3: Underreamed Drilled Pier.....	15

INDEX OF TABLES

	Page No.
Table 1.1: Project Description	1
Table 2.1: Site Description	3
Table 2.2: Field Exploration Summary.....	3
Table 2.3: Field Exploration Description	4
Table 2.4: Laboratory Testing Program	4
Table 2.5: Generalized Subsurface Profile Table	5
Table 3.1: Reconditioning Method for 1" PVM	9
Table 3.2: Compaction Recommendations.....	10
Table 3.3: WRI Waffle Slab Design Parameters.....	12
Table 3.4: PTI Waffle Slab Design Parameters	12
Table 3.5: Parameters for Axial Design.....	14
Table 3.6: Geotechnical Recommendations for Straight Shaft Pier Design	14
Table 3.7: Parameters for Axial Design.....	15
Table 3.8: Constraints for Underreamed Pier Design	16
Table 3.9: Parameters for Lateral Design using LPILE	16
Table 3.10: Drilled Pier Installation Considerations.....	16
Table 3.11: Suspended Floor Slab Considerations Table.....	18
Table 3.12: Suspended Floor Slab Crawl Space and Adjacent Flatwork Considerations	19
Table 3.13: Recommended Design Seismic Parameters	20
Table 4.1: Subgrade Preparation for Non-Structural - General Fill	22
Table 4.2: Fill Compaction Recommendations Outside of Building and Pavement Areas.....	22
Table 4.3: Considerations for Demolition, Abandoning Utilities and Tree Removal.....	22

1.0 PROJECT INFORMATION

1.1 PROJECT AUTHORIZATION

Professional Service Industries, Inc. (PSI), an Intertek company, has completed a field exploration and geotechnical evaluation for the proposed Holy Rosary Catholic Church project. Father Twumasi, representing Queen of Holy Rosary Catholic Church, authorized PSI's services on December 05, 2023, by approving PSI Proposal No. 411130. PSI's proposal contained a proposed scope of work, lump sum fee, and PSI's General Conditions.

1.2 PROJECT DESCRIPTION

Based on information provided by the Client, PSI's review of a site plan entitled "Queen of Holy Rosary Catholic Church, Hostyn, Texas", dated 10/21/2023 and prepared by RMA Architects, and the results of this geotechnical investigation a summary of our understanding of the proposed project is provided below in the following Project Description table.

TABLE 1.1: PROJECT DESCRIPTION

Project Description	Rebuilding a Catholic Church that burned down in Hostyn, Texas
Building Construction Type	1-Story 11,000 sf church
Existing Grade Change within Building Pad	1 foot
Existing Grade Change within Project Site	2 feet
Finished Floor Elevation	Assumed within 2 above existing grade
Requested or Anticipated Foundation Types	Drilled Piers w/ Suspended Slab or Waffle Slab
Maximum Design Column Loads	Estimated <150 kips
Maximum Design Wall Loads	Estimated <4.5 kips/ft

The geotechnical recommendations presented in this report are based on the available project information, structure locations, and the subsurface materials encountered during the field investigation. If the information presented above is incorrect, please inform PSI so that the recommendations presented in this report can be amended, as necessary. PSI will not be responsible for the implementation of provided recommendations if not notified of changes in the project.

1.3 PURPOSE AND SCOPE OF SERVICES

The purpose of this study is to evaluate the subsurface conditions at the site and develop geotechnical engineering recommendations and guidelines for use in preparing the design and other related construction documents for the proposed project. The scope of services included drilling soil borings, performing laboratory testing, and preparing this geotechnical engineering report.

This report briefly outlines the available project information, describes the site and subsurface conditions, and presents the following:

- General site development and subgrade preparation recommendations.
- Estimated potential soil movements associated with shrinking and swelling soils and consolidation settlement and methods to reduce these movements to acceptable levels.



- Recommendations for site excavation, fill compaction, and the use of on-site and imported fill material under pavements and the structures.
- Recommendations for building pad preparation for ground supported slabs having a maximum movement potential, due to heave or settlement, of **2-inches** and **1-inch**.
- Recommendations for the design of foundations for supporting the proposed structure, which will include Wire Reinforcing Institute (WRI) and Post-Tensioning Institute (PTI) design criteria for slab-on-grade foundations designed for a 1" potential vertical movement for a waffle slab option.
- Drilled pier design criteria including allowable end bearing and skin friction values, as well as LPILE design values for lateral load analysis for a drilled pier with suspended floor slab foundation option.
- Seismic design site classification per the International Building Code (2018).

The scope of services for this geotechnical exploration did not include an environmental, mold nor detailed seismic/fault assessment for determining the presence or absence of wetlands, or hazardous or toxic materials in the soil, bedrock, surface water, groundwater, or air on or below, or around this site. Statements in this report or on the boring logs regarding odors, colors, and unusual or suspicious items or conditions are strictly for informational purposes. The report also does not include a detailed settlement analysis or slope stability analysis.



2.0 SITE AND SUBSURFACE CONDITIONS

2.1 SITE DESCRIPTION

The following table provides a generalized description of the existing site conditions based on visual observations during the field activities, as well as other available information.

TABLE 2.1: SITE DESCRIPTION

Site Location	936 FM 2436, Hostyn, TX
Site History	Existing Church Facility
Existing Site Ground Cover	Bare ground, pavements, landscaping and scattered trees
Existing Grade/Elevation Changes	Relatively level
Description of Adjacent Property	North: Existing Church Parking Lot East: Open ground South: FM 2436 West: Cemetery
Ground Surface Soil Support Capability	Firm Enough for Field Equipment During Dry Periods

2.2 FIELD EXPLORATION

Field exploration for the project consisted of drilling a total of **three (3) borings**. The boring design element, approximate depths and drilling footage are provided in the following table.

TABLE 2.2: FIELD EXPLORATION SUMMARY

Design Element	Number of Borings	Boring Depth (ft)	Drilling Footage (feet)
New Building	3	30	90
TOTAL:	3	---	90

The boring locations were selected by PSI personnel and located in the field using a recreational-grade GPS system. Elevations of the ground surface at the boring locations were not provided and should be surveyed by others prior to construction, if required. We have estimated ground surface elevations at the boring locations from the topographic survey provided (or from Google Earth) and estimate an approximate 1-foot accuracy. The references to elevations of various subsurface strata are based on depths below existing grade at the time of drilling. The approximate boring locations are depicted on the Boring Location Plan provided in the Appendix.



TABLE 2.3: FIELD EXPLORATION DESCRIPTION

Drilling Equipment	Truck Mounted Drilling Equipment
Drilling Method	Continuous Flight Augers
Field Testing	Standard Penetration Testing (ASTM D1586)
Sampling Procedure	ASTM D1586
Sampling Frequency	Continuously to a Depth of 10 Feet and at 5-foot Intervals Thereafter
Frequency of Groundwater Level Measurements	During and After Drilling
Boring Backfill Procedures	Soil Cuttings
Sample Preservation and Transportation Procedure	General Accordance with ASTM D4220

During field activities, the encountered subsurface conditions were observed, logged, and visually classified (in general accordance with ASTM D2487). Field notes were maintained to summarize soil types and descriptions, water levels, changes in subsurface conditions, and drilling conditions.

2.3 LABORATORY TESTING PROGRAM

PSI supplemented the field exploration with a laboratory testing program to determine additional engineering characteristics of the subsurface soils encountered. The laboratory testing program included:

TABLE 2.4: LABORATORY TESTING PROGRAM

Laboratory Test	Procedure Specification
Visual Classification	ASTM D2488
Moisture Content	ASTM D2216
Atterberg Limits	ASTM D4318
Material Finer than No. 200 Sieve	ASTM D1140

The laboratory testing program was conducted in general accordance with applicable ASTM Test Methods. The results of the laboratory tests are provided on the Boring Logs in the Appendix. Portions of samples not altered or consumed by laboratory testing will be discarded 60 days from the date shown on this report.

2.4 SITE GEOLOGY

We reviewed the **Seguin Sheet of the Geologic Atlas of Texas** in an effort to determine the geologic setting of the project site and surrounding areas. The Geologic Atlas of Texas was developed by the Bureau of Economic Geology at The University of Texas using aerial photography, data from various oil and gas exploration companies, and very limited ground reconnaissance. Our review indicates that the project is located in the **Fleming Formation and Oakville Sandstone (M_{f0})** of Tertiary Geologic Age. The Fleming Formation and Oakville Sandstone (M_{f0}) consist of interbedded sand and clay.



2.5 SUBSURFACE CONDITIONS

The results of the field and laboratory investigation have been used to develop a generalized subsurface profile at the project site. The following subsurface descriptions highlight the major subsurface stratification features and material characteristics.

TABLE 2.5: GENERALIZED SUBSURFACE PROFILE TABLE

Top (ft)	Bot. (ft)	Soil Type	ω (%)	LL (%)	PI	-200 Sieve (%)	N
0	4.5 – 6.5	Fat Clay with Sand	11 – 30	60 – 88	40 – 65	79 – 86	6 – 22
		Fat Clay					
4.5 – 6.5	23.5	Lean Clay with Sand	10 – 19	34 – 49	16 – 33	74 – 89	14 – 50/5"
		Lean Clay					
23.5	28.5	Fat Clay	19 – 22	64 – 66	43 – 46	99 – 11	33 – 43
28.5	30	Lean Clay	15 – 18	49	29	100	64 – 66

Note:

1. ω = Moisture Content (%)
2. LL = Liquid limit (%)
3. PI = Plasticity Index
4. -#200 Sieve = % Passing the #200 Sieve
5. N = Standard Penetration Test blow count (blows/foot)

The boring logs included in the Appendix should be reviewed for specific information at the boring locations. The boring logs include soil descriptions, stratifications, locations of the samples, and field and laboratory test data. The descriptions provided on the logs only represent the conditions at the specific boring location. The stratifications represent the approximate boundaries between subsurface materials. The actual transitions between strata may be more gradual and less distinct. Variations will occur and should be expected across the site.

2.5.1 GROUNDWATER INFORMATION

Water level measurements were performed during drilling and after completion of drilling. Specific information concerning groundwater is noted on each boring log presented in the Appendix of this report. Groundwater **was not** encountered during the field investigation of this site.

Groundwater levels fluctuate seasonally as a function of rainfall, proximity to creeks, rivers and lakes, the infiltration rate of the soil, seasonal and climatic variations and land usage. In relatively pervious soils, such as sandy soils, the indicated depths are a relatively reliable indicator of groundwater levels. In relatively impervious soils, water levels observed in the borings may not provide a reliable indication of groundwater elevations, even after several days. If a detailed water level evaluation is required, observation wells or piezometers can be installed at the site to monitor water levels.

The groundwater levels presented in this report were measured at the time of PSI field activities. The contractor should be prepared to control groundwater, if encountered during construction activities.



3.0 GEOTECHNICAL EVALUATION AND RECOMMENDATIONS

3.1 GEOTECHNICAL DISCUSSION

Based upon the information gathered from the soil borings and laboratory testing, the clay soils encountered at this site within the seasonally active zone (estimated to extend to a depth of approximately 15 feet below the existing ground surface) have a **high** potential for expansion. PSI recommends the expansive potential (i.e. Potential Vertical Movement (PVM) of these soils be addressed in the design and construction of this project to reduce the potential for foundation movements.

An improved foundation pad must be constructed under soil supported floor slab and foundation elements due to the presence of expansive foundation soils. Several methods are available to reduce the shrink/swell movement. PSI typically recommends excavating unacceptable soils and, after scarifying and moisture conditioning the exposed subgrade, replacement with some of the removed existing excavation soils used as compacted reconditioned fill and finally select fill materials are placed and compacted up to the bottom of the floor slab.

PSI recommends that the planned structure either be supported on deep drilled piers with a suspended slab in order to reduce the potential for detrimental settlement or on a shallow soil-supported stiffened beam and slab-on-grade type foundation (Waffle Slab).

The following design recommendations have been developed based on the previously described project characteristics and subsurface conditions encountered. If there are changes in the project criteria, PSI should be retained to determine if modifications in the recommendations will be required. The findings of such a review would be presented in a supplemental report. Once final design plans and specifications are available, a general review by PSI is recommended to observe that the conditions assumed in the project description are correct and to verify that the earthwork and foundation recommendations are properly interpreted and implemented within the construction documents.

3.2 POTENTIAL VERTICAL MOVEMENT OF EXPANSIVE SOILS (PVM)

The soils encountered at the soil boring locations exhibit a **high** potential for volumetric changes, due to fluctuations in soil moisture content. PSI has conducted laboratory testing on the soils to estimate the expansive soil potential with soil moisture variations. These soil moisture variations are based on historical climate change data for a particular site. Determining the soil potential for shrinking and swelling, combined with historical climate variation, aids the engineer in quantifying the soil movement potential of the soils supporting the floor slab and shallow foundations based on climate variations. Shrink/swell movement procedures using two soil modeling systems, the Post Tensioning Institute's (PTI) "Design of Post-Tensioned Slabs-on-Ground, 3rd Edition" and Texas Department of Transportation (TxDOT) method TEX-124-E, were utilized to approximate the Potential Vertical Movement (PVM) for this location.

The anticipated shrink/swell movement (PVM) is a soil movement estimated in consideration of soil properties and climatic moisture changes at a particular geographic location. Foundations on expansive soils are designed with sufficient stiffness to resist these soil movements to an acceptable magnitude.



3.2.1 SHRINK/SWELL MOVEMENT (PVM) ESTIMATE

Based on laboratory testing results and the TEX-124-E and the PTI methods, the potential vertical movement within the proposed project area was estimated to be approximately **3-¾ inches**.

It is not possible to accurately quantify actual soil moisture changes and resulting shrink/swell movements. The PVM and referenced structural movement values provided should be considered approximate values based on industry standard practice and experience. Extreme soil moisture variations could occur due to unusual drought severity, leaking water or sewer lines, perched groundwater infiltration, or seasonal springs. Also, soil transpiration from trees located adjacent to or previously underneath the building, downspouts directing roof discharge under the foundation, poor drainage or irrigation line breaks could lead to excessive movements.

Therefore, because of these unknown factors, the shrink/swell potential of soils can often be significantly underestimated using the previously mentioned methods of evaluating PVM.

The unknown factors previously mentioned cannot be determined at the time of the geotechnical study. Therefore, estimated shrink/swell movements are calculated only in consideration of historical climate data related to soil moisture variations from climate changes. Movements in excess of those estimated should be anticipated and regular maintenance should be provided to address these issues throughout the life of the structure.

3.2.2 DESIGN PVM CONSIDERATIONS

Grade supported floor slabs, foundations and adjacent flatwork should be expected to undergo some vertical movements, including differential, due to the action of expansive soils and possible soil settlement. In this general area, most Owners, Architects, Structural and Geotechnical Engineers consider a value of **1-inch** to be within acceptable movement tolerances for grade supported floor slabs or foundations. This generally accepted tolerance for movement has been used by PSI in developing the recommendations for preparing the foundation pad for this project.

The amount of structural movement associated with a PVM magnitude of 1-inch may not be considered acceptable for “operational” or “aesthetic” performance criteria; which often occur at less movement than the magnitude of the PVM which is based on “structural” considerations. Cracking in the foundation and walls and sticking doors, which requires periodic maintenance, will likely occur for foundations designed using an allowable 1-inch PVM. This should be understood by the Owner and Design Team.

PSI recommends that the Owner discuss allowable movement tolerances with the structural engineer, architect, and any other pertinent members of the Design Team prior to commencement of the final design to make certain that appropriate movement tolerances are developed and used for this project. If design PVM values other than a 1-inch is desired, PSI should be contacted to review and revise the recommendations presented in this report as necessary to meet the project requirements.

If the risk of grade-supported foundation and floor slab movements is not deemed acceptable, or if the required foundation pad preparation costs for a soil supported foundation are determined to be excessive, it is our opinion that a drilled pier foundation with a structurally suspended floor slab be utilized for this project. We would be pleased to provide geotechnical recommendations for this foundation type if desired as a supplement to this report.



3.3 FOUNDATION RECOMMENDATIONS DISCUSSION

Based on information provided to PSI, information obtained during the field operations, results of the laboratory testing, and PSI's experience with similar projects, recommendations for the foundation types listed below are presented in this report:

- Stiffened beam and slab-on-grade foundation with 1" PVM, or
- A drilled pier foundation system with a suspended floor slab (2" PVM for adjacent flatwork)

If an alternative foundation type is desired, PSI can provide alternative recommendations in a supplemental letter upon request.

3.3.1 BUILDING PAD EARTHWORK RECOMMENDATIONS

3.3.1.1 RECONDITIONING METHOD

In order to achieve the desired PVM in the building area, building pad improvement should consist of removing the upper soils to the recommended minimum over-excavation depth, proofrolling and compacting the exposed subgrade, placement of Structural General Fill up to the bottom of reconditioned fill (on sloping sites), then placement and compaction of reconditioned removed soils or imported Reconditioned Fill up to the bottom of the select fill and finally compaction of the select fill to finish floor grade. This procedure is outlined in the following sections.

For areas below the Reconditioned Fill zone, Structural General Fill should be placed between the top of the compacted subgrade up to the bottom of the Reconditioned Fill. Reconditioned fill or Select fill could also be used in this zone.

The following illustrations and tables provide general requirements for the installation of a foundation pad that should provide a PVM magnitude of 2 inches or less or 1 inch or less using the *Undercut/Replace and Reconditioning Method*.



FIGURE 3.1: RECONDITIONING METHOD PAD IMPROVEMENT

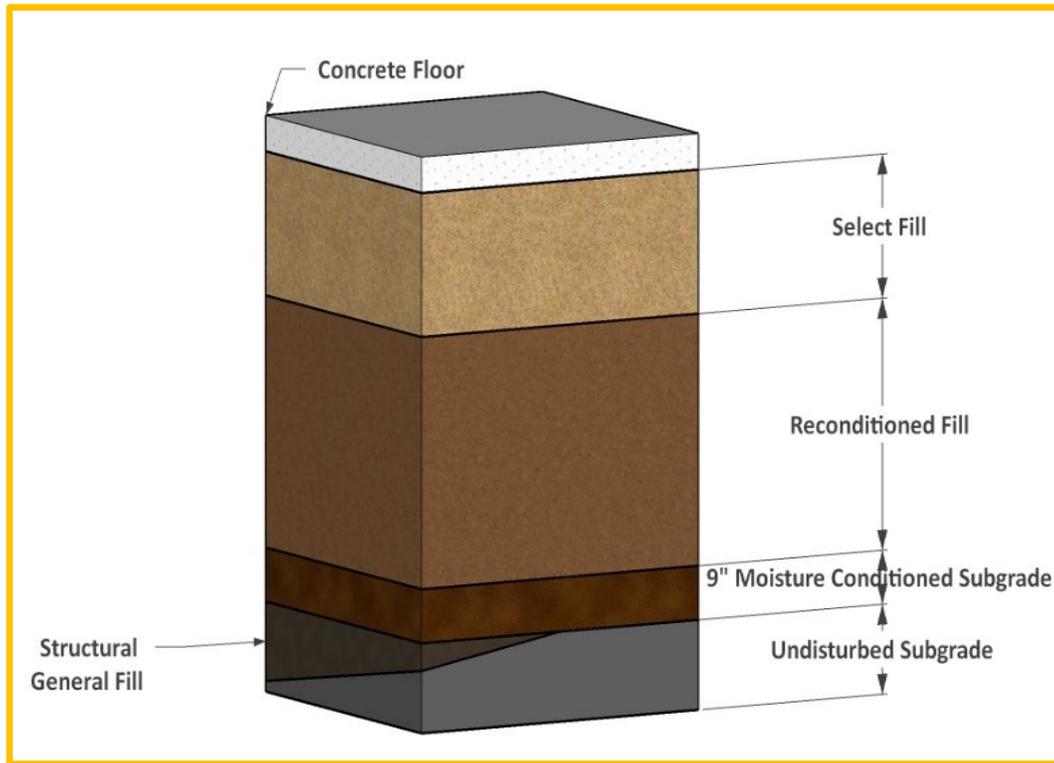


TABLE 3.1: RECONDITIONING METHOD FOR 1" PVM

Application	Stiffened beam and slab-on-grade foundation with 1" PVM, or Adjacent flat work for a drilled pier foundation system with a suspended floor slab (2" PVM)
Site Stripping Removal	Upper 6 inches of organics and deleterious material including debris to expose clean subgrade
Foundation Improvement Method	Remove and replace existing soils with reconditioned soil and select fill
Improved Site Condition PVM	Less than 2 inches or less than 1 inch
Minimum Over-Excavation (Assumes FFE within 2 feet of highest existing grade)	2" PVM: 3 feet 1" PVM: 5 feet
Horizontal Undercut Extent	Below all slab areas and at least 5 feet beyond the slab perimeter and extending the full width of flatwork that may be sensitive to movement
Subgrade Proof-Rolling	Proof-roll subgrade with rubber tired 20-ton (loaded) construction equipment; Alternate Equipment can be used with Geotechnical Engineer Approval; Remove rutting or excessively deflecting soils; Replace failing soils with compacted select fill material
Exposed Subgrade Treatment	Proof-roll then scarify, moisture condition, and compact 9 inches subgrade below base of undercut
Structural General Fill Thickness	As required to achieve the bottom elevation of Moisture Conditioned Subgrade
Structural General Fill Material Requirements	Clean on site or imported materials having: Allowable PI from 12 to 45 Percent Passing No. 200 Sieve > 35% Max Particle Size < 3"



Reconditioned Fill Thickness (min.)	2" PVM: 1 foot 1" PVM: 2 feet
Reconditioned Fill	On site or imported materials having: Allowable PI from 12 to 45 Percent Passing No. 200 Sieve > 50% Max Particle Size < 3"
On Site Soil Treatment for Reconditioned Fill Use	Possible 1% to 3% lime required to lower on site soil to PI 45 or less
Select Fill Thickness (min.)	2" PVM: 2 feet min. + as required to achieve bottom of floor slab 1" PVM: 3 feet min. + as required to achieve bottom of floor slab
Select Fill Material	Pit Run - Free of organics, trash, or other deleterious material. Liquid Limit <40% Plasticity Index 7 to 20 Max Particle Size < 3" Percent Material Passing 200 Sieve > 35%
Select Fill Material Alternative (Other low plasticity materials may be used pending review and approval from PSI)	TxDOT Item 247 (Crushed Limestone Material) Type A or B Grade 1, 2 or 3
Vapor Retarder Material	Approved by Architect/Structural Engineer
Maximum Loose Lift Thickness	8 inches
Time Between Reconditioned Fill and Select Fill Placement	Less than 4 days

3.3.2 COMPACTION AND TESTING RECOMMENDATIONS FOR FOUNDATION PAD AREAS

The following table outlines foundation pad compaction recommendations in consideration of appropriate vertical movement reduction method.

TABLE 3.2: COMPACTION RECOMMENDATIONS

Location	Material	Density Test Method	Plasticity Index	Percent Compaction	Optimum Moisture Content	Testing Frequency
Building Pad Areas	Subgrade, Reconditioned Fill, Structural General Fill	ASTM D698	PI ≥ 25	94% to 98%	≥ +2%	1 per 5,000 SF; min. 3 per lift
			PI < 25	≥ 95%	0 to +4%	
	Select Fill (Item 247 or Pit Run)	ASTM D698	PI ≤ 20	≥ 95%	-1 to +3%	

3.4 DESIGN MEASURES TO REDUCE CHANGES IN SOIL MOISTURE

The design and construction of a grade-supported foundation should include the following elements:

- Roof drainage should be controlled by gutters and carried well away from the structure.
- The ground surface adjacent to the building perimeter should be sloped and maintained a minimum of 5% grade away from the building for 10 feet to result in positive surface flow or



- drainage away from the building perimeter. In areas adjacent to the building controlled by ADA, concrete flatwork slopes should not be more than 2% within 10 feet of the building.
- Hose bibs, sprinkler heads, and other external water connections should be placed well away from the foundation perimeter such that surface leakage cannot readily infiltrate into the subsurface or compacted fills placed under the proposed foundations and slabs.
 - No trees or other vegetation over 6 feet in height shall be planted within 15 feet of the structure unless specifically accounted for in the foundation design.
 - Utility bedding should not include gravel near the perimeter of the foundation. Compacted clay or flowable fill trench backfill should be used in lieu of permeable bedding materials between 2 feet inside the building to 4 feet beyond the exterior of the building edge to reduce the potential for water to infiltrate within utility bedding and backfill material.
 - Paved areas around the structure are helpful in maintaining soil moisture equilibrium. It will be very beneficial to have pavement, sidewalks or other flatwork located immediately adjacent to the building to both reduce intrusion of surface water into the more permeable select fill and to reduce soil moisture changes along the exterior portion of the floor due to soil moisture changes from drought, excessive rainfall or irrigation, etc.
 - Flower beds and planter boxes should be piped or watertight to prevent water infiltration under the building.
 - Experience indicates that landscape irrigation is a common source of foundation movement problems and pavement distress. Repairing irrigation lines as soon as possible after leakage commences will benefit foundation performance greatly.
 - Building pad and pavement subgrade should be protected and covered within 48 hours to reduce changes in the natural moisture regime from rainfall events or excessive drying from heat and wind.

3.5 FOUNDATION DESIGN RECOMMENDATIONS

The following sections outline geotechnical design requirements for the recommended foundation options.

3.5.1 STIFFENED BEAM AND SLAB-ON-GROUND FOUNDATION (WAFFLE SLAB) RECOMMENDATIONS

A waffle slab type foundation is generally used to support relatively light structures where soil conditions are relatively uniform and where uplift and settlement can be tolerated. The intent of a stiffened beam and slab-on-grade foundation is to allow the structure and foundation to move with soil movements while providing sufficient stiffness to limit differential movements within the superstructure to an acceptable magnitude. The foundation may be designed using the Design of Slab-On-Ground Foundations published by the Wire Reinforcement Institute, Inc. (August 1981, updated March 1996). Alternately, the foundation may be designed using the 3rd Edition of the Design of Post-Tensioned Slabs-on-Ground published by the Post-Tensioning Institute (PTI DC10.1-08). The following table is applicable for a conventionally reinforced “Waffle Slab” with subgrade prepared in accordance with Section 3.3.1, which details foundation pad preparation and construction recommendations.



TABLE 3.3: WRI WAFFLE SLAB DESIGN PARAMETERS

Effective Plasticity Index	28
Soil/Climatic Rating Factor (1–C)	0.12
Allowable Bearing Pressure for Grade Beams	2,500 psf
Bearing Stratum at Bottom of Grade Beams	Compacted Select Fill or Reconditioned Fill
Penetration of Perimeter Beams Below Final Exterior Grade	At least 24 inches

PSI is providing PTI design values for the Structural Engineer’s design. These design values are estimated from the “Volflo” computer program in consideration of the soil conditions in the building area, an improved foundation pad having a 1-inch PVM and local experience. The following table is applicable for a conventionally reinforced or post-tensioned slab-on-grade with building prepared in accordance with Section 3.3.1, which details foundation pad preparation and construction recommendations.

TABLE 3.4: PTI WAFFLE SLAB DESIGN PARAMETERS

Edge Moisture Variation Distance Center Lift, e_m Edge Lift, e_m	8.8 feet 4.5 feet
Differential Soil Movement Center Lift, y_m Edge Lift, y_m	-0.95 inches 1.28 inches
Allowable Bearing Pressure for Grade Beams	2,500 psf
Bearing Stratum at Bottom of Grade Beams	Compacted Select Fill or Reconditioned Fill
Penetration of Perimeter Beams Below Final Exterior Grade	At least 24 inches

Utilities that project through slab and grade beam foundations should be designed either with some degree of flexibility or with sleeves in order to prevent damage to these lines as a result of vertical movement. Contraction, control or expansion joints should be designed and placed in interior wall partitions to minimize and control wall cracking as a result of foundation movements. Properly planned placement of these joints will assist in controlling the degree and location of material cracking which normally occurs due to material shrinkage, thermal affects, soil movements and other related factors.

3.5.2 DRILLED PIER RECOMMENDATIONS

Drilled shafts with a suspended floor slab are a recommended foundation system option for proposed building. The axial load carrying capacity of a drilled shaft can be computed using the static method of analysis. According to this method, axial capacity, Q , at a given penetration is taken as the sum of the skin friction on the side of the shaft, Q_f , and the end or point bearing at the shaft tip, Q_{eb} , so that:

$$Q = Q_f + Q_{eb} = f \cdot A_s + q \cdot A_p$$

where A_s and A_p represent, respectively, the embedded surface area and the end area of the shaft; f and q represent, respectively, the unit skin friction and the unit end or end bearing capacities.



The total allowable axial capacity in compression will be the summation of the allowable frictional capacity and the allowable end bearing capacity. The total allowable axial capacity in tension will be the allowable frictional capacity alone neglecting the end bearing component.

3.5.2.1 STRAIGHT SHAFT DRILLED PIERS

As an option, PSI recommends that the proposed building be supported on deep straight shaft drilled piers to minimize the potential for undesirable settlement and to reduce potential foundation movements as the structure support will be based below the seasonal active zone. The following illustrations and tables outline the requirements for drilled shaft design and construction considerations for support of these structures.

FIGURE 3.2: STRAIGHT SHAFT DRILLED PIER

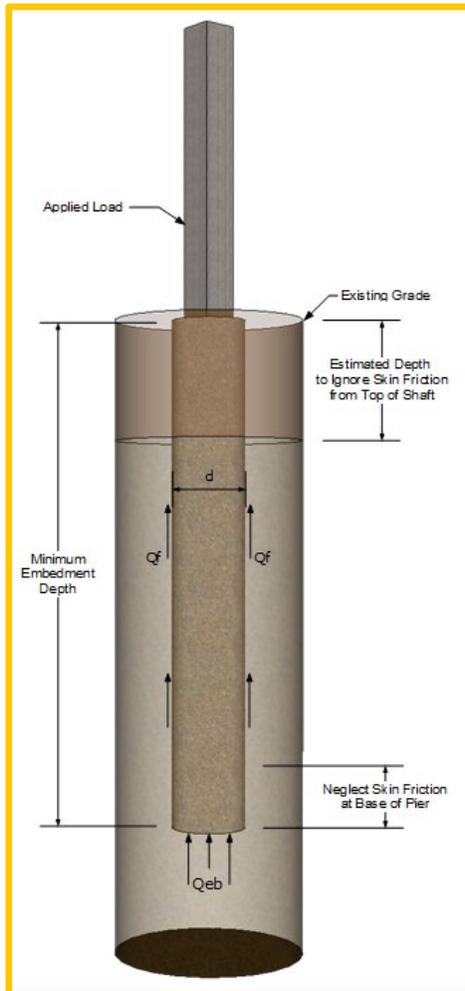


TABLE 3.5: PARAMETERS FOR AXIAL DESIGN

Material	Depth, feet	Allowable Skin Friction, Q_f , psf (F.S. = 2)	Allowable End Bearing, Q_{eb} , psf (F.S. = 3)	Uplift Force of Soil, kips
Select Fill	0 to 5	—	—	50d with d in feet
Clay	5 to 30	1,200	12,000	

TABLE 3.6: GEOTECHNICAL RECOMMENDATIONS FOR STRAIGHT SHAFT PIER DESIGN

Neglect Skin Friction from Top of Shaft	5 feet
Minimum Embedment Depth Below Original Grade	23 feet
Minimum Shaft Diameter, d	18 inches
Thickness to Neglect Skin Friction at Base of Shaft	1 Shaft Diameter
Uplift Resistance	Pier Weight + Dead Load + Allowable Skin Friction Below Active Zone
Minimum Shaft Spacing (center to center)	3 Shaft Diameters (3·d)
Possible Group Effect	If spacing < 3d consult Geotechnical Engineer
Min. Pier Vertical Reinforcing Steel	1% of gross cross-sectional area and as needed to resist uplift forces
Pier Tensile Reinforcing Steel	As Per ACI Code
Estimated Settlement	
Total Settlement	Less than 1 inch
Differential Settlement	Less than 0.5 inch

Notes: Detailed Settlement Analysis is outside of project scope

The minimum embedment depth was selected to locate the pier base below the depth of seasonal moisture change and within a specified desired stratum. Actual pier depths may need to be deeper depending upon the actual compressive loads on the pier.

3.5.2.2 UNDERREAMED DRILLED PIERS

As another option, PSI recommends that the proposed building be supported on deep underreamed drilled piers to minimize the potential for undesirable movement. The following illustrations and tables outline the requirements for the belled pier design and construction considerations.



FIGURE 3.3: UNDERREAMED DRILLED PIER

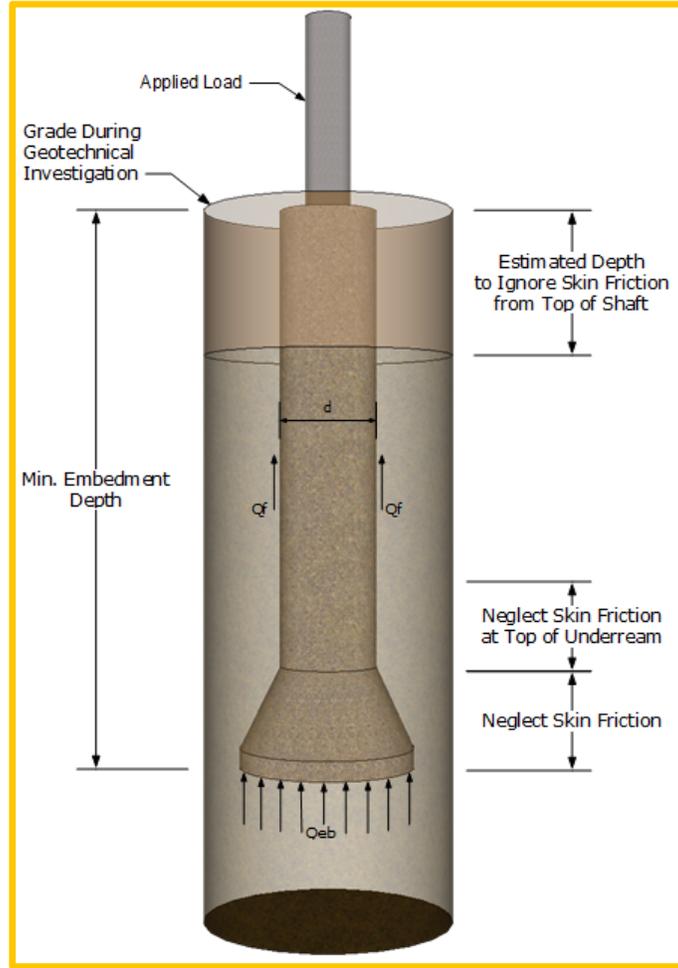


TABLE 3.7: PARAMETERS FOR AXIAL DESIGN

Material	Depth, feet	Allowable Skin Friction, Q_f , psf (F.S. = 2)	Allowable End Bearing, Q_{eb} , psf (F.S. = 3)	Uplift Force of Soil, kips
Clay/Select Fill	0 to 5	—	—	50d with d in feet
Clay	5 to 30	1,200	12,000	



TABLE 3.8: CONSTRAINTS FOR UNDERREADED PIER DESIGN

Neglect Skin Friction from Top of Shaft	5 feet
Min. Embedment Depth Below Original Grade	20 feet
Min. Shaft Diameter	18 inches
Maximum Bell to Shaft Ratio	2.5
Minimum Thickness to Neglect Skin Friction	Belled Portion and 1 Pier Diameter from Base of Pier
Uplift Resistance	$10 \times (B^2 - D^2)$ <i>Where: B is base diameter in feet</i> <i>D is shaft diameter in feet</i>
Minimum Shaft Spacing (center to center)	3 Shaft Diameters (3*d)
Possible Group Effect	If spacing is less than 3d consult Geotechnical Engineer
Min. Pier Vertical Reinforcing Steel	1% of gross cross-sectional area and as needed to resist uplift forces
Pier Tensile Reinforcing Steel	Per ACI Code
Estimated Settlement* Total Settlement Differential Settlement	Less than 1 inch Less than 0.5 inch

Notes: Detailed Settlement Analysis is outside project scope

3.5.2.3 LPILE DESIGN CRITERIA

Piers having lateral loads should be designed utilizing the following LPILE input parameters for this project.

TABLE 3.9: PARAMETERS FOR LATERAL DESIGN USING LPILE

Soil Type	Depth, feet	γ_e , pcf	c, psf	k_s , pci	k_c , pci	ϵ_{50}
Clay	0 – 5	115	1,000	225	100	0.009
Clay	5 – 30	120	3,500	2,000	1,000	0.004

Note: γ_e : Effective Soil Unit Weight
c: Undrained Cohesion for Clay
 k_s : Clay Static Loading Modulus of Subgrade Reaction (LPILE Manual Table 3-3)
 k_c : Clay Cyclic Loading Modulus of Subgrade Reaction (LPILE Manual Table 3-3)
 ϵ_{50} : Axial Strain Factor for Soil (LPILE Manual Table 3-2 and 3-4)

3.5.2.4 GENERAL PIER CONSTRUCTION RECOMMENDATIONS

TABLE 3.10: DRILLED PIER INSTALLATION CONSIDERATIONS

Recommended Installation Procedure	FHWA-NHI-10-016, May 2010
High-Torque Drilling Equipment Anticipated	Yes, in hard clay stratum
Groundwater Anticipated	No
Verification of Groundwater before Installation	Yes
Temporary Casing Anticipated	No



Concrete Placement after Drilling	Same Day as drilling. If concrete cannot be poured the same day as excavation, temporary casing or slurry may be needed to maintain an open excavation. Concrete should not be allowed to ricochet off the pier reinforcing steel nor off the side walls of excavation.
Concrete Slump	7 inches ± 1 inch
Permissible Water Accumulation in Excavation	Less than 2 inches
Concrete Installation Method for Water Infiltration	Tremie or pump to displace water
Reinforcing and Excavation to Cage Separation	3 times maximum size of coarse aggregate
Centralizers Recommended for Reinforcement	Yes
Cross Bracing within Reinforcement Cage	Not Recommended
Quality Assurance Monitoring by Geotechnical Engineer or Representative	Observe drilling of all piers During drilling, record tip of shaft depth Observe base material and cleanliness of base Observe placement of reinforcement

3.5.2.5 PIER FOUNDATION STRUCTURALLY SUSPENDED FLOOR CONSIDERATIONS

A drilled pier with a suspended floor slab has additional design considerations as outlined in this section. Although suspending the floor and the bottom of the grade beam spanning the piers will greatly reduce foundation movements compared to a soil supported slab, consideration must be given to proper techniques in utilizing carton forms in order to reduce damage or collapse during wet weather construction. Consideration should also be given to reducing the possibility of water intrusion under the foundation. This can lead to floor moisture infiltration through the floor and possibly mold issues. Also, water infiltration under the floor can cause foundation movements if the swelling soils heave the piers.

Since the pier supported buildings on deep drilled pier foundations are relatively fixed, any adjacent sidewalks or flatwork would be exposed to the estimated PVM movements; therefore, it is an important design consideration to mitigate the flatwork to an acceptable magnitude. PSI recommends improving the soils underneath adjacent sidewalks to at least a 2-inch PVM.



TABLE 3.11: SUSPENDED FLOOR SLAB CONSIDERATIONS TABLE

Initial Site Stripping	Upper 6 inches of organics and deleterious material including debris, tree roots, etc. to expose clean subgrade
Upper 9" Prepared Subgrade Compaction Requirements	At least 90% of the max standard Proctor (ASTM D-698) dry density at 0 to +4% of omc
Any General Fill Required to Achieve Grade: Placement and Compaction	Max. 9" loose lifts, compacted to at least 92% of the standard Proctor (ASTM D-698) maximum dry density at 0 to +4% of optimum moisture content
Min. Void Under Grade Beam and Floor Slab	8" minimum void to isolate the slab and grade beams from expansive soils from cardboard carton forms
Void Options Under Grade Beam and Floor	Carton forms (void boxes), soil retainers or formwork
Void Box Considerations	Care must be taken not to damage the boxes prior to or during concrete placement. The void boxes should have a tight fit to the pier foundations. They should be designed to deteriorate properly after construction so that pressures from swelling soils will collapse the carton forms rather than be transmitted to the overlying grade beams and/or floor slab. Thin layers of lean concrete are often placed over the void boxes to protect them from moisture during rebar placement operations. The contractor should be familiar with the proper installation and protection of the carton form system. The carton form supplier should provide technical assistance in order to instruct the workforce in proper carton form construction techniques.
Soil Retainers	Precast concrete panels or similar barrier material should be placed vertically along the exterior grade beams to prevent soil from sloughing under the grade beams and reduce the risk of significant water from migrating into the void space under the floor system.
Backfill Against Retainers and Exterior Grade Beams	Should consist of compacted clay soil to minimize movement of outside surface water from infiltrating under the floor system. The backfill clay soil should be compacted to at least 95 percent of the Standard Proctor max. dry density (ASTM D 698) at 0 to +4% of optimum moisture content.



TABLE 3.12: SUSPENDED FLOOR SLAB CRAWL SPACE AND ADJACENT FLATWORK CONSIDERATIONS

<p>Crawlspace Formwork Option Considerations</p>	<p>Provision should be made to collect and dispose of any water that may enter in the crawl space. This can be accomplished by constructing a 3-4-inch-thick, lean concrete slab “mudmat” on the surface of the crawl space. The “mudmat” should be sloped to drain to a sump where the water can be collected and pumped away from the building. Proper ventilation should be provided to help limit moisture from collecting in the crawl space. In some instances, forced-air-ventilation/circulation is used to reduce moisture accumulation and humidity in the crawl space. Mold growth may occur if the crawl space is not adequately ventilated.</p>
<p>Drainage Considerations</p>	<p>Final grading should promote positive drainage away from the structure. Positive drainage should be provided for the building so that surface water does not enter beneath the foundation or enter into air vents that may be situated in the exterior grade beam. Roof drains should be tied to storm drains or be discharged on top of pavements well outside of the building footprints. Soil landscaped areas within ten (10) feet of the structure should slope at a minimum of five (5) percent away from the building. Adjacent concrete flatwork or pavement should slope at a minimum two (2) percent away from the building.</p>
<p>Adjacent Sidewalks and Flatwork PVM Reduction to 2”</p>	<p>According to Table 3.1.</p>
<p></p>	<p></p>
<p></p>	<p></p>

PVM reduction will not eliminate movement of the flatwork. Rather, it will help to reduce those movements to acceptable levels. Differential movements would still be expected to occur between grade supported flatwork and the building foundations. Doweling the flatwork to the building foundation at common openings will further help to reduce the potential for differential movements and trip hazards. However, when doweling grade supported flatwork to a suspended structure, movements of the flatwork can cause cracking in the flatwork itself. We recommend that if grade supported flatwork is dowelled to the foundation, the connections be designed such that they are flexible to rotate. Alternatively, flatwork areas adjacent to pier supported structures can also be structurally suspended above grade and supported by drilled pier foundations.



3.6 SIDEWALKS AND FLATWORK

Other sidewalks or other flatwork located adjacent to grade-supported foundations, the undercutting and select fill placement operations for the building should extend beyond the perimeter of the building and pavements to at least the width of the adjacent sidewalk or flatwork. (max. 10 feet)

Any other sidewalks or flatwork not adjacent to buildings should be placed on an improved subgrade meeting or exceeding the pavement subgrade improvement methods previously recommended. If the sidewalk subgrade consists of material with a plasticity index of 25 or greater, 12 inches of select fill (provided in Section 3.3.1) should be placed below the sidewalk. The material should be compacted to 95% or greater than the maximum dry unit weight and contain a moisture content between -1 and +3% optimum moisture content.

Proper drainage around grade-supported sidewalks and flatwork is also very important to reduce potential movements. Elevating the sidewalks where possible and providing rapid, positive drainage away from them will reduce moisture variations within the underlying soils and will therefore provide valuable benefit in reducing the full magnitude of potential movements from being realized.

3.7 SITE SEISMIC DESIGN RECOMMENDATIONS

For the purposes of seismic design, based on the encountered site conditions and local geology, PSI interpreted the subsurface conditions to satisfy the **Site Class D** criteria for use at this site as defined by the International Building Code (IBC). The site class is based on the subsurface conditions encountered at the soil borings, the results of field and laboratory testing, experience with similar projects in this area, and considering the site prepared as recommended herein. The table below provides recommended seismic parameters for the project based on IBC 2018/ASCE 7-16.

TABLE 3.13: RECOMMENDED DESIGN SEISMIC PARAMETERS

Project/Structure Centroid Coordinates (WGS84 - Decimal Degree)	29.8467°; -96.9209°
Seismic Parameter	IBC 2018/ASCE 7-16
Site Class	D
Risk Category	II
0.2 sec (S_s)	0.06
1.0 sec (S_1)	0.034
Site Coefficient 0.2sec, F_a	1.6
Site Coefficient 1.0 sec, F_v	2.4
0.2 sec (S_{DS})	0.064
1.0 sec (S_{D1})	0.054



4.0 CONSTRUCTION CONSIDERATIONS

Geotechnical Engineer Involvement at the Time of Construction – Foundation pad preparation recommendations on expansive clay sites in this area depend on the soil moisture conditions that exist due to the prevailing climate at the time of construction as well as the expansive properties of the clay.

It is recommended that the foundation pad recommendations presented in this report be confirmed immediately prior to construction by the Geotechnical-Engineer-of Record (GER). Wetter climate conditions near the time of construction can lead to a significant reduction in pad preparation requirements which can often be a substantial percentage of site development cost.

Having a Geotechnical Engineer retained to review the earthwork recommendations in the Construction Documents and be an active participant in team meetings near the time of construction can often result in project cost savings. Therefore, PSI recommends that an AASHTO accredited 3rd party laboratory with qualified professional engineers who specialize in geotechnical engineering be retained to provide observation and testing of construction activities involved in the foundations, earthwork, pavements and related activities of this project. As the GER, PSI's services can be retained as the 3rd party laboratory. PSI's participation would be advantageous to the project flow and value engineering during construction since we are most familiar with the existing soil conditions at the site.

The geotechnical engineer often does not have available all design information at the time of writing the original report since the report is done very early in the design process. The GER can be of great benefit immediately prior to construction since definitive information regarding the location of the building, surrounding flatwork, pavements, planned landscaping, and drainage features is available at that time. The GER can then write Supplement letters to the original geotechnical report often resulting in less risk and significant project cost savings.

PSI cannot accept responsibility for conditions which deviate from those described in this report, nor for the performance of the foundations or pavements if not engaged to also provide construction observation and materials testing for this project. The PSI geotechnical engineer of record should also be engaged by the Design Team during construction, even if periodic on-call testing is contracted with PSI Construction Services.



4.1 INITIAL SITE PREPARATION CONSIDERATIONS

4.1.1 SUBGRADE PREPARATION FOR SITE WORK OUTSIDE BUILDING PAD AND PAVEMENT AREAS

Grade adjustments outside of the foundation pad and pavement areas can be made using select or general fill materials. The clean excavated onsite soils may also be reused in areas not sensitive to movement.

TABLE 4.1: SUBGRADE PREPARATION FOR NON-STRUCTURAL - GENERAL FILL

Minimum Undercut Depth	6 inches or as needed to remove roots, organic and/or deleterious materials
Exposed Subgrade Treatment	Proof-roll subgrade with rubber-tired 20-ton (loaded) construction equipment Alternate Equipment can be used with Geotechnical Engineer Approval
Proof-Rolled Pumping and Rutting Areas	Excavate to firmer materials and replace with compacted general or select fill under direction of a representative of the Geotechnical Engineer
General Fill Type	Any clean material free of roots, debris and other deleterious material with a maximum particle size of 4 inches
Maximum General Fill Loose Lift Thickness	8 inches

TABLE 4.2: FILL COMPACTION RECOMMENDATIONS OUTSIDE OF BUILDING AND PAVEMENT AREAS

Location	Material	Test Method for Density Determination	Plasticity Index	Percent Compaction	Optimum Moisture Content	Testing Frequency
Outside of Structure / Pavement Areas	General Fill	ASTM D698	PI ≥ 25	94% to 98%	0 to +4%	1 per 10,000 SF; min. 3 per lift
			PI < 25	≥ 95%	0 to +4%	

4.1.2 EXISTING SITE CONDITIONS

The following table outlines construction considerations in consideration of demolition of existing structures, demolition of existing paving, procedures for abandoning old utility lines and removing trees.

TABLE 4.3: CONSIDERATIONS FOR DEMOLITION, ABANDONING UTILITIES AND TREE REMOVAL

Existing Structures	
Foundations of former structures located below new footprint of proposed structure	Impact of foundation of former structures should be evaluated on a case by case basis
Foundations for former structures located below new paving	Cut off at least 3 feet below finished paving grade
Existing Pavement	
Former paving located within footing of proposed structures	Remove concrete and/or HMAC surface course and base entirely or review impact on case by case basis
Former paving located within footprint of proposed new paving	Remove concrete and/or HMAC surface course and evaluate if base can be reused
Abandoned Utilities	



Utilities of former structures located within new footprint of proposed structure	Remove pipe, bedding and backfill and then replace with select fill placed using controlled compaction
Utilities of former structures located outside of footprint of proposed structure	Abandon in place using a grout plug
Tree Removal	
Trees located within proposed building footprint; roadways, parking, and sidewalk areas; and within 15 feet of building area	Remove root system for full vertical and lateral extent and extend removal for at least 3 feet beyond presence of root fragments and replace void with compacted general fill or flowable fill

4.2 MOISTURE SENSITIVE SOILS/WEATHER RELATED CONCERNS

Soils are sensitive to disturbances caused by construction traffic and changes in moisture content. During wet weather periods, increases in the moisture content of the soil can cause significant reduction in the soil strength and support capabilities. In addition, soils which become wet may be slow to dry and thus significantly retard the progress of grading and compaction activities. It will, therefore, be advantageous to perform earthwork, foundation, and construction activities during dry weather. A relatively all-weather compacted crushed limestone cap having a thickness of at least 6 inches should be provided as a working surface.

4.3 EXCAVATION OBSERVATIONS

Excavations should be observed by a representative of PSI prior to continuing construction activities in those areas. PSI needs to assess the encountered materials and confirm that site conditions are consistent with those discussed in this report. This is especially important to identify the condition and acceptability of the exposed subgrades under foundations and other structures that are sensitive to movement. Soft or loose soil zones encountered at the bottom of the excavations should be removed to the level of competent soils as directed by the Geotechnical Engineer or their representative. Cavities formed as a result of excavation of soft or loose soil zones should be backfilled with compacted select fill or lean concrete.

After opening, excavations should be observed, and concrete should be placed as quickly as possible to avoid exposure to wetting and drying. Surface run-off water should be drained away from the excavations and not be allowed to pond. Excavations left open for more than 48 hours should be protected to reduce evaporation or entry of moisture.

4.4 DRAINAGE CONSIDERATIONS

Water should not be allowed to collect in or adjacent to foundation excavations, on foundation surfaces, or on prepared subgrades within the construction area during or after construction. Proper drainage around grade supported sidewalks and flatwork is important to reduce potential movements. Excavated areas should be sloped toward one corner to facilitate removal of collected rainwater, groundwater, or surface runoff. Providing rapid, positive drainage away from the building reduces moisture variations within the underlying soils and will aid in reducing the magnitude of potential movements.

4.5 EXCAVATIONS AND TRENCHES

Excavation equipment capabilities and field conditions may vary. Geologic processes are erratic and large variations can occur in small vertical and/or lateral distances. Details regarding “means and methods” to



accomplish the work (such as excavation equipment and technique selection) are the sole responsibility of the project contractor. The comments contained in this report are based on small diameter borehole observations. The performance of large excavations may differ as a result of the differences in excavation sizes.

The Occupational Safety and Health Administration (OSHA) Safety and Health Standards (29 CFR Part 1926, Revised October 1989), require that excavations be constructed in accordance with the current OSHA guidelines. Furthermore, the State of Texas requires that detailed plans and specifications meeting OSHA standards be prepared for trench and excavation retention systems used during construction. PSI understands that these regulations are being strictly enforced, and if they are not closely followed, the owner and the contractor could be liable for substantial penalties.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's "responsible person", as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, State, and Federal safety regulations.

PSI is providing this information as a service to the client. PSI does not assume responsibility for construction site safety or the contractor's or other parties' compliance with local, State, and Federal safety or other regulations. A trench safety plan was beyond the scope of our services for this project.



5.0 REPORT LIMITATIONS

The recommendations submitted in this report are based on the available subsurface information obtained by PSI and design details furnished by the client for the proposed project. If there are revisions to the plans for this project, or if deviations from the subsurface conditions noted in this report are encountered during construction, PSI should be notified immediately to determine if changes in the foundation recommendations are required. If PSI is not notified of such changes, PSI will not be responsible for the impact of those changes on the project.

The Geotechnical Engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional Geotechnical Engineering practices in the local area. No other warranties are implied or expressed. This report may not be copied without the expressed written permission of PSI.

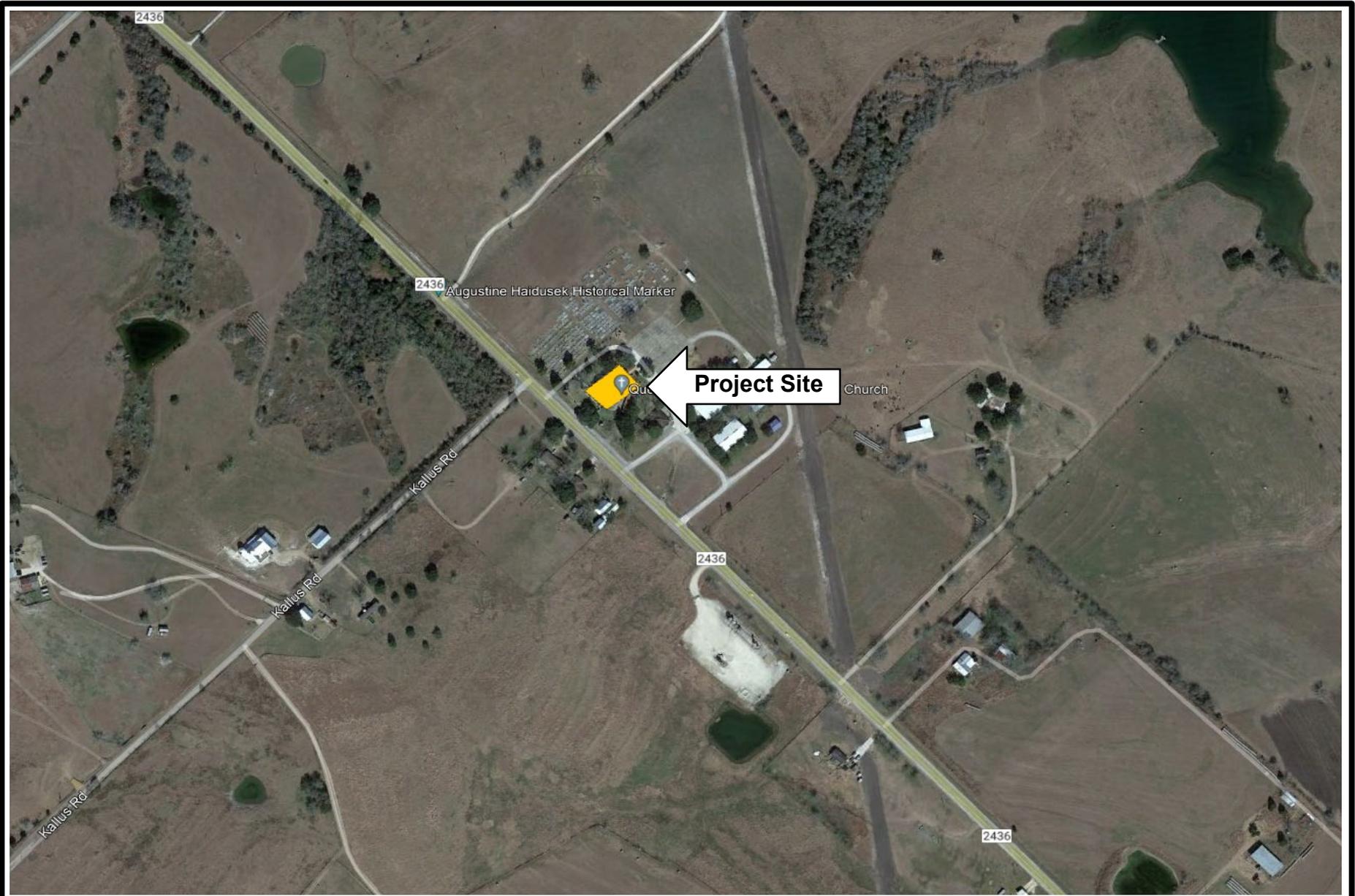
After the plans and specifications are more complete, the Geotechnical Engineer should be retained and provided the opportunity to review the final design plans and specifications to check that the engineering recommendations have been properly incorporated in the design documents. At this time, it may be necessary to submit supplementary recommendations. If PSI is not retained to perform these functions, PSI will not be responsible for the impact of those conditions on the project.

This report has been prepared for the exclusive use of Queen of Holy Rosary Catholic Church for specific application to the proposed Holy Rosary Catholic Church to be constructed at 936 FM 2436 in LaGrange, Texas.



APPENDIX





3 Burwood Lane, San Antonio, Texas
(210) 342-9377 FAX (210) 342-9401

Site Vicinity Map

Proposed Holy Rosary Catholic Church
936 FM 2436
LaGrange, Texas
PSI Project No.: 0312-3058

NOT TO SCALE



● - Approximate Boring Location



3 Burwood Lane, San Antonio, Texas
 (210) 342-9377 FAX (210) 342-9401

Boring Location Plan

Proposed Holy Rosary Catholic Church
 936 FM 2436
 LaGrange, Texas
 PSI Project No.: 0312-3058

NOT TO SCALE



Boring Logs

Holy Rosary Catholic Church
936 FM 2436 LaGrange, Texas

Project No. 0312-3058

BORING B-01

LOCATION: See Boring Location Plan

DEPTH, FT.	SYMBOL SAMPLES WATER	SOIL DESCRIPTION	MOISTURE CONTENT	% RETAINED #4	% PASSING #200	SPT (N) & TCP (T) VALUES	% REC	%RQD	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	HAND PEN (TSF) ● UNC CMP (TSF)			UNCONF. COMP. (TSF)	UNIT DRY WT. (LB/CU FT)
												2.0	4.0	6.0		
		Elevation:										PL	WC	LL		
												20	40	60		
5		FAT CLAY (CH) with SAND, brown, stiff to very stiff	11			22										
			28	0	85	10			88	23	65					
			18			17										
10		LEAN CLAY (CL), tan, very stiff to hard	17	0	89	26			34	16	18					
			18			27										
15			14			31										
20			16			52										
25		FAT CLAY (CH), tan, hard	22	0	100	33			66	20	46					
30		LEAN CLAY (CL), tan, hard	18			65										
35		Boring terminated at approximately 30 feet.														

COMPLETION DEPTH: 30.0 Feet

DATE: 12/27/23



DEPTH TO GROUND WATER

SEEPAGE (ft.): NONE ENCOUNTERED

END OF DRILLING (ft.): NONE ENCOUNTERED

DELAYED WATER LEVEL (FT): NONE ENCOUNTERED

Holy Rosary Catholic Church
936 FM 2436 LaGrange, Texas
Project No. 0312-3058

BORING B-02

LOCATION: See Boring Location Plan

DEPTH, FT.	SYMBOL SAMPLES WATER	SOIL DESCRIPTION	MOISTURE CONTENT	% RETAINED #4	% PASSING #200	SPT (N) & TCP (T) VALUES	% REC	%RQD	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	HAND PEN (TSF) ● UNC CMP (TSF)			UNCONF. COMP. (TSF)	UNIT DRY WT. (LB/CU FT)
												2.0	4.0	6.0		
		Elevation:										PL	WC	LL		
												20	40	60		
0 - 5	Diagonal hatching	FAT CLAY (CH), brown, stiff	12			14										
5 - 10	Diagonal hatching	LEAN CLAY (CL) with SAND, tan, very stiff to hard	19			16										
10 - 15	Diagonal hatching		18			22										
15 - 20	Diagonal hatching		10	0	74	45			49	16	33					
20 - 25	Diagonal hatching		13			55										
25 - 30	Diagonal hatching	FAT CLAY (CH), tan, hard	22			43										
30 - 35	Diagonal hatching	LEAN CLAY (CL), tan, hard	17	0	100	64			49	20	29					
35		Boring terminated at approximately 30 feet.														

COMPLETION DEPTH: 30.0 Feet

DATE: 12/27/23



DEPTH TO GROUND WATER

SEEPAGE (ft.): NONE ENCOUNTERED

END OF DRILLING (ft.): NONE ENCOUNTERED

DELAYED WATER LEVEL (FT): NONE ENCOUNTERED

Holy Rosary Catholic Church
936 FM 2436 LaGrange, Texas
Project No. 0312-3058

BORING B-03

LOCATION: See Boring Location Plan

DEPTH, FT.	SYMBOL SAMPLES	WATER	SOIL DESCRIPTION	MOISTURE CONTENT	% RETAINED #4	% PASSING #200	SPT (N) & TCP (T) VALUES	% REC	%RQD	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	HAND PEN (TSF) ● UNC CMP (TSF)			UNCONF. COMP. (TSF)	UNIT DRY WT. (LB/CU FT)
													2.0	4.0	6.0		
			Elevation:										PL	WC	LL		
			FAT CLAY (CH) with SAND, brown, firm to very stiff	30			6										
				24	0	79	19			60	20	40					
5			LEAN CLAY (CL) with SAND, tan, very stiff to hard	15			14										
				14			44										
				10			75										
10																	
				16	0	77	52			39	19	20					
15																	
				17			67										
20																	
			FAT CLAY (CH), tan, hard	19	0	99	37			64	21	43					
25																	
			LEAN CLAY (CL) with SAND, tan, hard	15			66										
30			Boring terminated at approximately 30 feet.														
35																	

COMPLETION DEPTH: 30.0 Feet

DATE: 12/27/23



DEPTH TO GROUND WATER

SEEPAGE (ft.): NONE ENCOUNTERED

END OF DRILLING (ft.): NONE ENCOUNTERED

DELAYED WATER LEVEL (FT): NONE ENCOUNTERED

KEY TO TERMS AND SYMBOLS USED ON LOGS

ROCK CLASSIFICATION

RECOVERY

DESCRIPTION OF RECOVERY	% CORE RECOVERY
Incompetent	< 40
Competent	40 TO 70
Fairly Continuous	70 TO 90
Continuous	90 TO 100

ROCK QUALITY DESIGNATION (RQD)

DESCRIPTION OF ROCK QUALITY	RQD
Very Poor (VPo)	0 TO 25
Poor (Po)	25 TO 50
Fair (F)	50 TO 75
Good (Gd)	75 TO 90
Excellent (ExInt)	90 TO 100

CONSISTENCY OF COHESIVE SOILS

CONSISTENCY	N-VALUE (Blows/Foot)	SHEAR STRENGTH (tsf)	HAND PEN VALUE (tsf)
Very Soft	0 TO 2	0 TO 0.125	0 TO 0.25
Soft	2 TO 4	0.125 TO 0.25	0.25 TO 0.5
Firm	4 TO 8	0.25 TO 0.5	0.5 TO 1.0
Stiff	8 TO 15	0.5 TO 1.0	1.0 TO 2.0
Very Stiff	15 TO 30	1.0 TO 2.0	2.0 TO 4.0
Hard	>30	>2.0 OR 2.0+	>4.0 OR 4.0+

SOIL DENSITY OR CONSISTENCY

DENSITY (GRANULAR)	CONSISTENCY (COHESIVE)	THD (BLOWS/FT)	FIELD IDENTIFICATION
Very Loose (VLo)	Very Soft (VSo)	0 TO 8	Core (height twice diameter) sags under own weight
Loose (Lo)	Soft (So)	8 TO 20	Core can be pinched or imprinted easily with finger
Slightly Compact (SICmpt)	Stiff (St)	20 TO 40	Core can be imprinted with considerable pressure
Compact (Cmpt)	Very Stiff (VSt)	40 TO 80	Core can only be imprinted slightly with fingers
Dense (De)	Hard (H)	80 TO 5"/100	Core cannot be imprinted with fingers but can be penetrated with pencil
Very Dense (VDe)	Very Hard (VH)	5"/100 to 0"/100	Core cannot be penetrated with pencil

DEGREE OF PLASTICITY OF COHESIVE SOILS

DEGREE OF PLASTICITY	PLASTICITY INDEX (PI)	SWELL POTENTIAL
None or Slight	0 to 4	None
Low	4 to 20	Low
Medium	20 to 30	Medium
High	30 to 40	High
Very High	>40	Very High

BEDROCK HARDNESS

MORHS' SCALE	CHARACTERISTICS	EXAMPLES	APPROXIMATE THD PEN TEST	
5.5 to 10	Rock will scratch knife	Sandstone, Chert, Schist, Granite, Gneiss, some Limestone	Very Hard (VH)	0" to 2"/100
3 to 5.5	Rock can be scratched with knife blade	Siltstone, Shale, Iron Deposits, most Limestone	Hard (H)	1" to 5"/100
1 to 3	Rock can be scratched with fingernail	Gypsum, Calcite, Evaporites, Chalk, some Shale	Soft (So)	4" to 6"/100

MOISTURE CONDITION OF COHESIVE SOILS

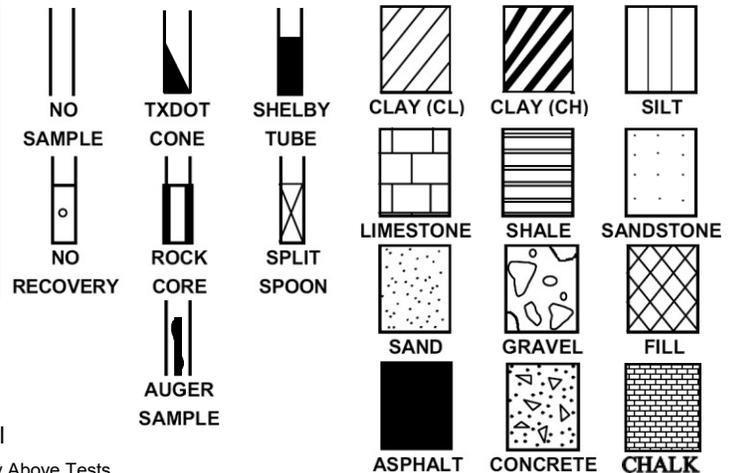
DESCRIPTION	CONDITION
Absence of moisture, dusty, dry to touch	DRY
Damp but no visible water	MOIST
Visible free water	WET

RELATIVE DENSITY FOR GRANULAR SOILS

APPARENT DENSITY	SPT (BLOWS/FT)	CALIFORNIA SAMPLER (BLOWS/FT)	MODIFIED CA. SAMPLER (BLOWS/FT)	RELATIVE DENSITY (%)
Very Loose	0 to 4	0 to 5	0 to 4	0 to 15
Loose	4 to 10	5 to 15	5 to 12	15 to 35
Medium Dense	10 to 30	15 to 40	12 to 35	35 to 65
Dense	30 to 50	40 to 70	35 to 60	65 to 85
Very Dense	>50	>70	>60	85 to 100

SAMPLER TYPES

SOIL TYPES



ABBREVIATIONS

PL – Plastic Limit
 LL – Liquid Limit
 WC – Percent Moisture

Q_P – Hand Penetrometer
 Q_U – Unconfined Compression Test
 UU – Unconsolidated Undrained Triaxial

Note: Plot Indicates Shear Strength as Obtained By Above Tests

WATER SEEPAGE

WATER LEVEL AT END OF DRILLING

U.S. STANDARD SIEVE SIZE(S)

CLASSIFICATION OF GRANULAR SOILS

6"	3"	3/4"	4	10	40	200	
BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE	
							CLAY

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Providing testing for virtually all types of building products, construction materials, and systems for safety, retail, code, and performance purposes.

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The ETL and Warnock Hersey Marks show a product or system's conformance to code and ensures the on-going verification of compliance.

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Providing on-site services of opening systems that need to be re-labeled or making recommendations for upgraded materials.

Industrial Hygiene Services
Assessing a building or facility for a variety of sources (air, asbestos, lead, mold) to minimize the risk of factors adverse to human health.

Building Enclosure Commissioning
Design and construction professionals provide solutions to reduce the potential for premature building failure, increase a building's energy efficiency, and expected life cycle.

Mock-Up & Field Testing
On-site (air infiltration, water leakage, and structural performance for fenestration) or in lab validation of a curtain wall's design, workmanship, and material selection to ensure its performance.

Property Management Support Services
Providing a variety of building systems testing, inspection, and consulting services to optimize the value and life of the property asset.

Decommissioning & Due Diligence
Supporting the redevelopment and transfer of property assets via environmental and property assessments and engineering services.





The ever increasing challenges of designing, constructing, and maintaining a building can be difficult for any organization to navigate. From compliance to local and national codes, to ensuring an efficient design, to property management, Intertek-PSI's team of architects, engineers, scientists, and technicians understand firsthand the complexities of successfully constructing a commercial building. Our full suite of services give us unique insight into all phases of a project. Regardless of the project size or complexity, Intertek-PSI delivers engineering, consulting, and testing services to support site selection, design, construction, and property management.

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SECTION 02 41 00 –DEMOLITION

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

SECTION INCLUDES

- A. Selective demolition of remnants of existing building and selected elements as shown on drawings or required. Include removal of existing utilities as indicated or encountered; removal of concrete footings, concrete piers, septic systems, mechanical, electrical and plumbing lines as indicated or required.
- B. The extent of this work is to be determined by site inspection in addition to information given on the drawings and in various sections of the specifications. The drawings contain general information relative to the construction of these buildings. As noted on the plans and now restated here, neither the Owner nor the Architect guarantees or warrants in any way this information. It is the sole responsibility of any and all Contractors or Subcontractors to verify these quantities and building descriptions for themselves prior to submitting their proposal.
- C. The Owner will identify or remove any items they wish to retain from the site prior to the pre-proposal conference.
- D. All site elements present or not identified by the Owner at the time of the pre-proposal conference and indicated in the plans to be demolished can be considered by any Contractor submitting a proposal on this project to accrue to that Contractor upon the award and execution of a contract on this project. It is assumed by the Owner that any value of such material will be considered by the Contractor in an effort to reduce the ultimate overall cost to the Owner for demolition and disposal of these items.

REQUIREMENTS

- A. Site Investigation:
 - 1. By starting this project, the Contractor acknowledges that he has investigated and satisfied himself as to:
 - a. The conditions affecting the work, including but not limited to physical conditions of the site that may bear upon site access, handling and storage of tools and materials, access to water, electric or other utilities that might otherwise affect performance of required activities.
 - b. The character and quantity of all surface and subsurface materials or obstacles to be encountered in so far as this information is reasonably ascertainable from an inspection of the site, including exploratory work done by the Owner or Designated Consultant, as well as information presented in drawings and specifications included with this contract.
 - c. Federal, State, and local laws and regulations that may affect cost, progress and performance of the work.

SUBMITTALS

- A. General: Submit the following in accordance with Conditions of the Contract and Division 1.
 - 1. Itemized Demolition Schedule indicating sequence of demolition work for review prior to start of work. Include coordination for shutoff, capping and continuation of utility services as required.

2. Detail all demolition methods to be used including but not limited to dust and noise control protection.
3. Photographs of existing conditions of structure, earthwork and utilities

PERMITS

- A. Procure and pay for all necessary permits or certificates required to complete the work specified. Make any and all required notifications and comply with all applicable Federal, State and local ordinances.

QUALITY ASSURANCE

- A. Provide at least one (1) person who shall be present and in charge of the Demolition Work at all times and who shall be thoroughly familiar with all phases of all work performed under this Section.
- B. Comply with all pertinent codes and regulations applying to this work.

JOB CONDITIONS

- A. Use all means necessary to prevent the spread of dust during performance of this work. Provide additional clean filters for the existing air handling system serving those areas to remain to protect them from construction dust.
- B. Use all means necessary to protect the existing buildings and site elements to remain from all types of damage, including fire, water damage, and unnecessary interruption of utility services. In the event of damage of any kind, immediately make all repairs and replacements necessary to the approval of the Owner at no additional cost to the Owner.
- C. Motor driven equipment shall have functional mufflers.
- D. Visit the site and examine the existing structures. Note all conditions as to the character and extent of work involved.

GENERAL

- A. Provide all barricades, shoring, and bracing necessary to protect the tenants, workmen, and Public from danger. Barricades shall be sufficiently designed to protect and or exclude the public from all hazards.
- B. Conduct Demolition operations and debris removal to ensure minimum interference with roads, streets, walks, and other adjacent facilities. Do not close, block or otherwise obstruct streets or walks without written permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways as required by the City.
- C. Maintain existing utilities indicated to remain in service and protect them against damage during demolition. Do not interrupt utilities serving occupied or used facilities, except when authorized in writing by the Owner. Provide temporary services during interruptions of existing utilities as required.

- D. All other materials, not specifically described but required for proper completion of Work of this Section, shall be as selected by the Contractor subject to the approval of the Owner.
- E. Perform demolition work in manner so as to allow Owner's use of existing facilities.
- F. Perform demolition work in order to maintain Owner's construction schedule.

EXECUTION

DEMOLITION

- A. Before commencing the Work of this Section, verify with the Owner that all items to be removed by the Owner have been removed. Schedule the work in a careful manner with all necessary consideration for the Public and the Owner. All items of existing equipment and materials or any other item of value to the Owner shall be salvaged by the Owner prior to demolition.
- B. All material removed under this Contract, which is not to be salvaged or reused, shall become the property of the Contractor and be promptly removed from the site. At all times use movable debris boxes, covered, to convey the material through the building. Do not store or permit debris to accumulate on the site. Dumpsters shall not overflow and shall be emptied on a regular basis. Remove all debris from the building premises and leave the construction site "Clean" each day. All debris shall be dumped in an approved disposal facility and all fees for this shall be paid by the Contractor. Contractor is responsible for completely removing all demolished materials from the site and disposing of them in accordance with all local, State and Federal Regulations. If Contractor fails to remove debris promptly, Owner reserves the right to have debris removed at Contractor's expense.
- C. Conduct operations so as not to interfere with adjacent occupied spaces, roads, streets, drives, walks, service lines and the like.
- D. Keep all pedestrian areas clear for passage at all times.

PROTECTION OF STRUCTURES, PROPERTY

- A. Execute demolition work to ensure adjacent property no damage from falling debris or other causes.
- B. Take precautions to guard against movement, settlement, or be liable for such movement, settlement, or collapse; repair promptly such damage when so ordered.
- C. Repair damage to Owner's property or any other person or persons on or off premises by reason of required work.

END OF SECTION 02 41 00

SECTION 03 10 00 - CONCRETE FORMWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

The work of this section includes all labor, materials and equipment required to form all cast-in-place concrete shown on the drawings including but not limited to all slabs, joists, beams, walls, stairs, and equipment pads.

1.3 CODES AND STANDARDS

Comply with the provision of the following codes, specifications and standards except where more stringent requirements are shown or specified:

- A. ACI 301 "Specifications for Structural Concrete for Buildings"
- B. ACI 318 "Building Code Requirements for Reinforced Concrete"
- C. Concrete Reinforcing Steel Institute "Reinforced Concrete, Manual of Standard Practice"
- D. ACI SP-4 "Formwork for Concrete"

In addition, all formwork shall be designed, erected, supported, braced, and maintained as a minimum according to ACI Standard 347 "Guide to Formwork".

1.4 RESPONSIBILITY

The design, construction and safety of all formwork shall be the responsibility of the General Contractor. The Contractor shall also be responsible for determining when temporary supports, shores, backshores, and other bracing may be safely removed.

PART 2 - PRODUCTS

2.1 FORMS FOR EXPOSED FINISH CONCRETE

Unless otherwise specified, formwork for exposed concrete surfaces shall consist of plywood, metal, metal framed plywood, or other acceptable surface. Formwork shall provide a continuous straight and smooth surface conforming to the joint system as specified on the Architect's drawings. Form material shall have sufficient thickness to withstand pressure of concrete without bow or deflection. Plywood shall be overlaid plywood complying with U.S. Product Standard PS-1 "A-C or B-B High Density Overlaid

Concrete Form", Class I, or plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood", Class I, Exterior Grade or better, mill-oiled and edge sealed, with each piece bearing legible inspection trademark.

2.2 FORMS FOR UNEXPOSED FINISH CONCRETE

Unless otherwise specified, formwork for unexposed concrete surfaces shall be constructed with plywood, lumber, metal or other acceptable material. Lumber shall be dressed on at least two edges and one side for tight fit.

2.3 FORMWORK COATINGS

Formwork coatings shall be a commercial formulation that will not bond with, stain, nor adversely affect concrete surfaces or impair subsequent treatment of concrete surfaces requiring bond or adhesion, nor impede curing with water or curing compounds. Provide a product that has a maximum VOC (Volatile Organic Compounds) of 350 mg/l but not greater than permitted by the local government agency having jurisdiction in the area where the project is located.

2.4 NAILS AND FASTENERS

Use only galvanized nails and fasteners for securing formwork in structures exposed to weather or unconditioned spaces such as garages, canopies and porte-cocheres.

PART 3 - EXECUTION

3.1 FABRICATION AND CONSTRUCTION

- A. Design, erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation and position. Maintain formwork construction tolerances complying with ACI 347.
- B. Design formwork to be readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials.
- C. Construct forms to sizes, shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.
- D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming

keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.

- E. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and patch forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.
- F. Chamfer exposed corners and edges as indicated, using wood, metal, PVC or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
- G. Form Ties:

Factory-fabricated, adjustable-length, removable or snapoff metal form ties, designed to prevent form deflection, and to prevent spalling concrete surfaces upon removal. Unless otherwise indicated, provide ties so portion remaining within concrete after removal is 1 1/2" inside concrete and will not leave holes larger than 1" diameter in concrete surface. Provide only galvanized form ties in structures exposed to weather or unconditioned spaces.

- H. Provisions for Other Trades:

Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses and chases from trades providing such items. Accurately place and securely support items built into forms.

3.2 CLEANING AND TIGHTENING

Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and all other debris just prior to concrete placement. Retighten forms and bracing prior to concrete placement as required to prevent mortar leaks and maintain proper alignment.

3.3 CLEANING AND RE-USE OF FORMS

Forms reused in the work shall be repaired and cleaned. Split, frayed, delaminated, or otherwise damaged facing material will not be acceptable for exposed surfaces. Forms intended for successive concrete placement shall have surfaces cleaned, fins and laitance removed, and joints tightened to avoid surface offsets. New form coating compound shall be applied to reused forms. Thin form-coating compounds only with thinning agent of type, and in amount, and under conditions of form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

3.4 TOLERANCES

Unless specified otherwise, all tolerances for concrete formwork shall conform to ACI Standard 117, "Standard Tolerances for Concrete Construction and Materials". Before concrete placement the Contractor shall check lines and levels of erected formwork and make any corrections and adjustments as required to ensure proper size and location of concrete members and stability of forming systems. During concrete placement the Contractor shall check formwork and supports to ensure that forms have not displaced and that completed work will be within specified tolerances.

3.5 SHORES AND SUPPORTS

A. Definitions

1. Shores: Vertical or inclined support members designed to carry the weight of formwork, concrete, and construction loads above.
2. Reshores: Shores placed snugly under a stripped concrete structural member after the original forms and shores have been removed from the member, thus requiring the member to carry its own weight and superimposed construction loads at the time of installation. Reshores are assumed to carry no load at the time of installation. After the installation of reshores, superimposed construction loads are assumed to be distributed among all members connected by reshores.
3. Backshores: Shores placed snugly under a stripped concrete structural member after the original formwork and shores have been removed from a small area without allowing the structural member to deflect or support its own weight or superimposed construction loads. It is assumed that backshores carry the same load as that carried by the original shores they replace.

Comply with ACI 347 for shoring, reshoring and backshoring in concrete construction and as herein specified where more stringent:

B. Structures with Three Supported Levels or Less:

Extend shoring from soil supported slab or suitable subgrade to uppermost level for structures with three structurally supported levels or less.

3.6 REMOVAL OF FORMS AND SUPPORTS

A. Curing and Stripping Concrete Cylinders:

The General Contractor shall be responsible for making and curing stripping concrete cylinders, cured under field conditions, for the purpose of determining concrete strength at time of form and shore removal. Such cylinders shall be made by the Contractor and tested by his testing laboratory.

B. Formwork Not Supporting Concrete:

Formwork not supporting concrete such as sides of beams, walls, columns and similar parts of the structure, may be removed after cumulatively (not necessarily consecutively) curing at not less than 50°F for 12 hours after placing concrete, provided the concrete is sufficiently hard so as not to be damaged by form removal operations and provided curing and protection operations are maintained. If ambient air temperatures remain below 50°F or if retarding agents are used, then this specified minimum period should be increased as required to safely remove the forms without damage to the concrete. Where such forms also support formwork for slab or beam soffits, the removal times of the latter shall govern.

END OF SECTION 03 10 00

SECTION 032000 - CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

The work of this section includes labor, materials, hardware, equipment, transportation and services required to fabricate and place all reinforcement for cast-in-place concrete including bars, welded wire fabric, ties and supports shown on the drawings and as specified.

1.3 QUALITY ASSURANCE

A. Codes and Standards:

Comply with all provisions of the following codes, specifications and standards except where more stringent requirements are shown or specified:

1. ACI 315, "ACI Manual of Standard Practice for Detailing Reinforced Concrete Structures".
2. ACI 318, "Building Code Requirements for Reinforced Concrete."
3. Concrete Reinforcing Steel Institute, "Reinforced Concrete, Manual of Standard Practice".
4. Concrete Reinforcing Steel Institute, "Placing Reinforcing Bars."

1.4 SHOP DRAWINGS

A. Shop drawings and samples for all reinforcing steel and related accessories shall be submitted for the Engineer's approval.

B. Shop Drawings shall show layout, bending and assembly diagrams, bar schedules, stirrup spacing, splicing and laps of bars and shall be prepared in accordance with ACI 315.

1.5 TESTING AND INSPECTION

Perform all tests and inspections specified in Laboratory Testing Section of these specifications.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Reinforcement:

1. Reinforcing Steel:

All reinforcing steel shall conform to the " Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement," ASTM A615 Grade 60 unless noted otherwise on the drawings. All reinforcing steel required to be welded shall conform to ASTM A 706 "Standard Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement".

2. Tie Wire:

Tie wire shall be annealed steel tie wire, minimum 16 gauge. Provide only plastic coated or stainless steel tie wire in exposed concrete structures and all architectural concrete.

B. Supports for Reinforcement:

Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI recommendations.

1. Slabs-on-Grade:

Use supports with sand plates or horizontal runners.

2.2 SPLICES

A. Splice Type and Lap Lengths:

Required splice type and lap lengths are defined on the drawings. Lap splice lengths for unscheduled bars not shown otherwise on the drawings shall be 40 bar diameters minimum.

PART 3 - EXECUTION

3.1 FABRICATION AND DELIVERY

A. Bending and Forming:

Fabricate bars of indicated sizes and accurately form to shapes and lengths indicated and required, by methods not injurious to materials. Do not heat reinforcement for bending. Bars with kinks or bends not scheduled will be rejected.

B. Marking and Shipping:

Bundle reinforcement and tag with suitable identification to facilitate sorting and placing. Transport and store at site so as not to damage material. Keep sufficient supply of tested, approved and proper reinforcement at the site to avoid delays. Maintain reinforcing bars free of mud, dirt, grease, or other coating.

3.2 PLACING REINFORCEMENT

- A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports and as herein specified.
- B. Before placing and again before concrete is placed, clean reinforcement of loose rust and mill scale, earth, ice and other materials which reduce or destroy bond with concrete.
- C. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers, as required. Exercise particular care to maintain proper distance and clearance between parallel bars and between bars and forms. Provide metal spreaders and spacers to hold steel in position. Support steel at proper height upon approved chairs.
- D. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- E. Coordinate with other trades and expedite materials and labor to avoid omissions and delay.
- F. Install waterproof membrane or moisture barrier as specified prior to placing steel for concrete slabs-on-grade.
- G. Extend reinforcement continuous through construction joints or, if approved on the shop drawings, provide dowels of sufficient length to develop the full tension or compression strength of the bar as applicable.
- H. Provide and place additional reinforcing steel at all sleeves and openings in beams, slabs and walls as specified on the drawings. Where reinforcement is interrupted by sleeves or openings not shown on the drawings, consult with Engineer for instructions for placing and splicing of bars. Provide required additional reinforcing steel at no additional cost to the Owners.

3.3 REINFORCING STEEL SPACING AND COVERAGE

A. Reinforcing Steel Coverage

Reinforcing steel coverage should conform to the requirements specified in the General Notes. Cover specified shall be considered minimums that may require

increasing where reinforcing steel intersects for different member types. Cover in structural members not specified in the General Notes shall conform to the requirements of ACI 318-08 Section 7.7 unless specified otherwise on the drawings.

B. Reinforcing Steel Spacing:

The clear distance between parallel bars in a layer shall be not less than the bar diameter nor 1". Where parallel reinforcement is placed in 2 or more layers, bars in the upper layer shall be placed directly above bars in the lower layer with clear distance between layers of not less than 1".

3.4 SPLICING REINFORCING STEEL

- A. All lap splices in reinforcing steel shall be contact lap splices unless detailed otherwise on the drawings.
- B. Maintain proper cover between reinforcing bars at splices.
- C. Lap unscheduled reinforcing bars not otherwise specified a minimum of 40 bar diameters at splices. Lap welded wire fabric a minimum of one full wire mesh plus two inches.

3.5 SHRINKAGE AND TEMPERATURE REINFORCEMENT

Provide shrinkage and temperature reinforcement at right angles to main top and bottom bars for all structural slabs unless detailed otherwise on the drawings. See drawings for sizes and spacings.

3.6 MECHANICAL AND PLUMBING REQUIREMENTS

Refer to Mechanical and Plumbing Drawings for formed concrete requiring reinforcing steel. Such reinforcement shall be furnished as part of the work of this section.

3.9 QUALITY CONTROL TESTING DURING CONSTRUCTION

See Testing Laboratory Services section of these specifications for concrete reinforcement inspection and test requirements.

END OF SECTION 03 20 00

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. Extent of concrete work is shown on drawings, including schedules, notes and details which show size and location of members and type of concrete to be poured. Furnish all labor, materials, services, equipment and hardware required in conjunction with or related to the forming, delivery and pouring of all poured-in-place concrete work.
- B. Architectural Concrete is specified in other Division-3 sections.

1.3 QUALITY ASSURANCE

The Contractor is responsible for quality control, including workmanship and materials furnished by his subcontractors and suppliers.

- A. Codes and Standards: Comply with provisions of following codes, specifications and standards, except where more stringent requirements are shown or specified:
 - 1. ACI 301 - "Specifications for Structural Concrete for Buildings".
 - 2. ACI 302 - "Guide for Concrete Floor and Slab Construction".
 - 3. ACI 304 - "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete".
 - 4. ACI 305 - "Recommended Practice for Hot Weather Concreting".
 - 5. ACI 306 - "Recommended Practice for Cold Weather Concreting".
 - 6. ACI 318 - "Building Code Requirements for Reinforced Concrete".
- B. Document Precedence: In case of conflict among documents, including architectural and structural drawings and specifications, notify the Architect prior to submitting proposal. In case of conflict between the structural drawings and specifications, the strictest interpretation shall govern.
- C. Materials and installed work may require testing and retesting, as directed by the Architect/Engineer, at any time during progress of work. Allow free access to material stockpiles and facilities. Tests, not specifically indicated to be done at the Owner's expense, including retesting of rejected materials and installed work, shall be done at the Contractor's expense. See Testing Laboratory section of the Specifications.

Inspection or testing by the Owner does not relieve the Contractor of his responsibility to perform the Work in accordance with the Contract Documents.

1.4 SUBMITTALS

- A. **Product Data:** Submit manufacturer's product data with application and installation instructions for proprietary materials and items, including admixtures, patching compounds, epoxies, grouts, waterstops, joint systems, curing compounds, dry-shake finish materials, hardeners, sealers and others as requested by Architect/Engineer.
- B. **Samples:** Submit samples of materials specified if requested by Architect/Engineer, including names, sources and descriptions.
- C. **Laboratory Test Reports and Mix Designs:** Submit laboratory test reports for concrete materials and mix designs as specified in the Testing Laboratory section of the Specifications.
- D. **Material and Mill Certificates:** Provide material and mill certificates as specified herein and in the Testing Laboratory section of the Specifications. Material and mill certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.
- E. **Construction Joints:** There shall be no construction joints for slab on grade, structural floors or columns where they are not indicated on the drawings.

1.5 PROVISION FOR OTHER WORK

Provide for installation of inserts, hangers, metal ties, anchors, bolts, angle guards, dowels, thimbles, slots, nailing strips, blocking, grounds and other fastening devices required for attachment of work. Properly locate in cooperation with other trades and secure in position before concrete is poured. Do not install sleeves in any concrete slabs, beams or columns except where shown on the drawings or upon written approval of the Architect/Engineer.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

Refer to the drawings for classes and strengths of concrete required.

- A. **Portland Cement:**
ANSI/ASTM C 150, Type I or Type III, unless otherwise approved by the Architect/Engineer.

Use one brand of cement, for each class of concrete, throughout the project, unless approved otherwise by the Architect/Engineer and the Testing Laboratory.
- B. **Normal Weight Aggregates:** ANSI/ASTM C 33, and as herein specified. Provide aggregates from a single source for exposed concrete.
- C. **Water:** Clean, fresh, drinkable, free of oils, acids or organic matter.

- D. Air-Entraining Admixture: ANSI/ASTM C 260. Provide air entrainment in all concrete used for vehicular traffic and parking or concrete permanently exposed to the weather as specified in Table 4.5.1 of ACI 318. Submit manufacturer's certification that product conforms to the requirements specified.
- E. Water-Reducing Admixture: ANSI/ASTM C 494, Type A. See maximum permissible chloride ion content in concrete specified below. Submit manufacturer's certification that product conforms to the requirements specified.
- F. High-Range Water-Reducing Admixture (Super Plasticizer): ASTM C 494, Type F or Type G. See maximum permissible chloride ion content in concrete specified below. Submit manufacturer's certification that product conforms to the requirements specified.
- G. Water-Reducing, Accelerator Admixture (Non-Corrosive, Non-Chloride): ASTM C 494, Type C or E. See maximum permissible chloride ion content in concrete specified below. Submit manufacturer's certification that product conforms to the requirements specified.
- H. Water-Reducing, Retarding Admixture: ASTM C 494, Type D. See maximum permissible chloride ion content in concrete specified below. Submit manufacturer's certification that product conforms to the requirements specified.
- I. Specification for Pozzolan Admixtures: Fly ash or other pozzolans used as admixtures may be used provided they conform to "Specification for Fly Ash and/or Calcined Natural Pozzolans for Use in Portland Cement Concrete", ASTM C 618 Class C or F. Fly ash replacement of cement shall not exceed 20% (one part fly ash max. to four parts cement) by weight. Fly ash may not be used in architecturally exposed concrete. Submit manufacturer's certification that product conforms to the requirements specified.
- J. Admixtures containing Chloride Ions: Admixtures containing chloride ions shall not be used in concrete containing galvanized or aluminum embedments, concrete containing high early strength cement (Type III), or concrete exposed to sulfate containing solutions such as soils with a water soluble sulfate content more than 0.20 percent by weight and all water with a sulfate content more than 1500 parts per million. Admixtures containing more than 0.05% chloride ions shall not be permitted. The maximum chloride ion content in concrete for corrosion protection shall be as follows:

Type of Member of Cement	Max. Water Soluble Chloride Ion in Concrete at 28 Days, % by weight
Reinforced Concrete and other structures, which may be exposed to chloride in service	0.15
Reinforced Concrete in buildings and other structures that will be dry or protected from	

moisture in service	1.00
All other reinforced concrete construction	0.30

The Contractor shall have the Concrete Supplier verify in a written submittal to the Architect/Engineer and Testing Laboratory that the chloride ion content in all concrete mix designs used on the project will not exceed limits stated above.

- K. Prohibited Admixtures: Calcium chloride, thiocyanates or admixtures containing more than 0.05% chloride ions are not permitted.
- L. Certification: Written conformance to the above mentioned requirements and the chloride ion content of the admixture will be required from the admixture manufacturer prior to mix design review by the Engineer.

2.2 RELATED MATERIALS

- A. Waterstops: Provide waterstops at all construction joints and other joints in all foundation walls below grade and where shown on the drawings. Size to suit joints.
 - 1. Rubber waterstops: Corps of Engineers CRD-C 513.
 - 2. Polyvinyl chloride (PVC) waterstops: Corps of Engineers CRD-C 572.
 - 3. Preformed Plastic Waterstops: Federal Specifications SS-S-210A "Sealing Compound for Expansion Joints".
- B. Moisture Barrier: Provide moisture barrier cover over prepared base material where indicated. Use only materials, which are resistant to decay when tested in accordance with ANSI/ASTM E 154.
- C. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.
- D. Moisture-Retaining Cover: Complying with ANSI/ASTM C 171:
- E. Non-slip Aggregate Finish: Provide fused aluminum oxide grits, or crushed emery, as abrasive aggregate for non-slip finish with emery aggregate containing not less than 40% aluminum oxide and not less than 25% ferric oxide. Use material that is factory-graded, packaged, rust-proof and non-glazing, and is unaffected by freezing, moisture and cleaning materials.
- F. Colored Wear-Resistant Finish: Packaged, dry, combination of materials, consisting of portland cement, graded quartz aggregate, coloring pigments (if required) and plasticizing admixtures. Use coloring pigments that are finely ground, non-fading mineral oxides, interground with cement. Color, as selected by Architect, unless otherwise indicated. Submit manufacturer's certification that product conforms to the requirements specified.

- G. Liquid Membrane-Forming Curing Compound:
Liquid type membrane forming curing compound complying with ANSI/ASTM C 309, Type I, Class A unless otherwise acceptable to the Architect/Engineer. Submit manufacturer's certification that product conforms to the requirements specified.
- H. Chemical Curing/Floor Hardener Compound: A clear liquid chemically acting compound of sodium silicate that performs as a curing agent with a penetrating compound that changes the free lime in the concrete to calcium silicate, resulting in a surface having a maximum abrasion coefficient of $0.25 \text{ cm}^3/\text{cm}^2$ when tested in accordance with ASTM C 118. Submit manufacturer's certification that product conforms to the requirements specified.
- I. Chemical Hardener: Colorless aqueous solution containing a blend of magnesium fluosilicate and zinc fluosilicate combined with a wetting agent, containing not less than 2 lb. of fluosilicates per gal. Submit manufacturer's certification that product conforms to the requirements specified.
- J. Bonding Compound: Polyvinyl acetate or acrylic base, rewettable type for use in cosmetic nonstructural repairs.
- K. Epoxy Products: Two component material suitable for use on dry or damp surface, complying with ASTM C 881, for use in all structural concrete repairs.
- L. Self-Leveling Mortars for Slab Fill Repair:
- M. Expansion Bolts in Concrete:
1. ICBO Approval: Only concrete anchors approved by the International Conference of Building Officials (ICBO) with a published Research Report shall be approved for use.
 2. Type: All expansion bolts in concrete shall be only wedge type expansion bolts.
 3. Interior Use: All expansion bolts, nuts and washers for use in interior conditioned environments free of potential moisture shall be manufactured from carbon steel zinc plated in accordance with Federal Specification QQ-Z-325C, Type II, Class 3.
 4. Exterior or Exposed Use: All expansion bolts, nuts and washers for use in exposed or potentially wet environments, or for attachment of exterior cladding materials shall be galvanized or stainless steel. Galvanized bolts, nuts and washers shall conform to ASTM A 153. Stainless steel bolts shall be manufactured from 300 series stainless steel and nuts and washers from 300 series or Type 18-8 stainless steel.
 5. Nuts and Washers: Nuts and washers shall be furnished from the manufacturer and used with the bolts.

N. Non-Shrink Grout:

1. Type: Grout for base plates and bearing plates shall be a non-metallic, shrinkage resistant, premixed, non-corrosive, non-staining product containing Portland cement, silica sands, shrinkage compensating agents and fluidity improving compounds.
2. Specifications: Non-shrink grout shall conform to Corps of Engineers Specification for Non-Shrink Grout, CRD-C621-83.
3. Compressive Strength: Twenty-eight day compressive strength as determined by grout cube tests, shall be:
 - a. 6,000 PSI for supporting concrete 3000 psi and less.
 - b. 8,000 PSI for supporting concrete greater than 3000 psi and less than or equal to 4000 psi.
 - c. 10,000 PSI for supporting concrete greater than 4000 psi.

2.3 PROPORTIONING AND DESIGN OF MIXES

- A. Refer to Testing Laboratory section of the Specifications.

2.4 CONCRETE MIXES

- A. Ready-Mix Concrete:
Comply with requirements of ANSI/ASTM C 94, "Ready Mixed Concrete" and Testing Laboratory section of the specifications.

PART 3 - EXECUTION

3.1 JOINTS IN CONCRETE

- A. Construction Joints: Locate and install construction joints as indicated on the drawings or if not shown on drawings, located so as not to impair strength and appearance of the structure, as acceptable to Architect/Engineer.
1. Place construction joints in the center one third of spans unless specified otherwise. Continue reinforcement across construction joints. Submit construction joint locations not shown on the drawings for Engineer's approval.
 2. Waterstops: Provide waterstops in construction joints as indicated on the Architectural and Structural Drawings. Install waterstops to form continuous diaphragm in each joint. Make provisions to support and protect exposed waterstops during progress of work. Fabricate field joints in waterstops in accordance with manufacturer's printed instructions.

3.2 INSTALLATION OF EMBEDDED ITEMS

- A. General: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached thereto.
- B. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support types of screed strips by use of strike-off templates or accepted compacting type screeds.

3.3 PREPARATION OF FORM SURFACES

- A. Clean reused forms of concrete matrix residue, repair and patch as required to return forms to acceptable surface condition.
- B. Coat contact surfaces of forms with a form-coating compound before reinforcement is placed.
- C. Thin form-coating compounds only with thinning agent of type, and in amount, and under conditions of form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in forms or to come into contact with concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

3.4 CONCRETE PLACEMENT

- A. Preplacement Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel and items to be embedded or cast-in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.
- B. Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel.
- C. Comply with ACI 304, Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete, and as herein specified.
 - 1. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.
 - 2. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

3. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309 recommended practices.
4. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6" into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.
5. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.
6. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
7. Bring slab surfaces to correct level with straightedge and strikeoff. Use highway straightedges, bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
8. Maintain reinforcing in proper position during concrete placement operations.

3.5 FINISH OF FORMED SURFACES

- A. Rough Form Finish: Provide rough form finish for formed concrete surfaces not exposed-to-view in the finish work unless otherwise indicated. This is the concrete surface having texture imparted by form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4" in height rubbed down or chipped off.
- B. Smooth Form Finish: Provide smooth form finish for formed concrete surfaces exposed-to-view or that are to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, painting or other similar system. This is as-cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed.
- C. Smooth Rubbed Finish: Provide smooth rubbed finish to scheduled concrete surfaces, which have received smooth form finish treatment, not later than one day after form removal. Moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced. Do not apply cement grout other than that created by the rubbing process.

- D. Grout Cleaned Finish: Provide grout cleaned finish to scheduled concrete surfaces, which have received smooth form finish treatment.
1. Combine one part portland cement to 1-1/2 parts fine sand by volume, and mix with water to consistency of thick paint. Proprietary additives may be used at Contractor's option. Blend standard portland cement and white portland cement, amounts determined by trial patches, so that final color of dry grout will closely match adjacent surfaces.
 2. Thoroughly wet concrete surfaces and apply grout to coat surfaces and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep damp by fog spray for at least 36 hours after rubbing.
- E. Related Unformed Surfaces: At tops of walls, horizontal offsets surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.6 MONOLITHIC SLAB FINISHES

- A. Scratch Finish: Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds for tile, portland cement terrazzo and other bonded applied cementitious finish flooring material, and as otherwise indicated. After placing slabs, plane surface to tolerance specified below. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set, with stiff brushes, brooms or rakes.
- B. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo, and as otherwise indicated. After screeding, consolidating and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to a tolerance as specified below. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
- C. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint or other thinfilm finish coating system. After floating, begin first trowel finish operation using power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with a level surface to a tolerance as specified below. Grind smooth surface defects, which would telegraph through applied floor covering system.

- D. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply trowel finish as specified above, then immediately follow with slightly scarifying surface by fine brooming.
- E. Non-Slip Broom Finish: Apply non-slip broom finish to ramps less than 6% exterior concrete platforms, steps and elsewhere as indicated. Immediately after trowel finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
- F. Rake Finish: Provide a rake finish to all ramps exceeding a 6% slope. Finish shall be applied perpendicular to direction of traffic.
- G. Chemical-Hardener Finish: Apply chemical-hardener finish to interior concrete floors where indicated. Apply liquid chemical-hardener after complete curing and drying of the concrete surface. Dilute liquid hardener with water (parts of hardener/water as follows), and apply in 3 coats; first coat, 1/3-strength; second coat, 1/2-strength; third coat, 2/3-strength. Evenly apply each coat and allow 24 hours for drying between coats.

Apply proprietary chemical hardeners, in accordance with manufacturer's printed instructions. After final coat of chemical-hardener solution is applied and dried, remove surplus hardener by scrubbing and mopping with water.

- H. Non-slip Aggregate Finish: Apply non-slip aggregate finish to concrete stair treads, platforms, ramps and elsewhere as indicated on the Architect's or Structural Drawings.

After completion of float finishing, and before starting trowel finish, uniformly spread 25 lb. of dampened non-slip aggregate per 100 sq. ft. of surface. Tamp aggregate flush with surface using a steel trowel, but do not force below surface. After broadcasting and tamping, apply trowel finishing as herein specified. After curing, lightly work surface with a steel wire brush, or an abrasive stone, and water to expose non-slip aggregate.

- I. Colored Wear-Resistant Finish: Provide colored wear-resistant finish to monolithic slab surface indicated.

Apply dry shake materials for colored wear-resistant finish at rate of not less than 60 lbs. per 100 sq. ft., unless greater amount is recommended by material manufacturer.

Immediately following first floating operation, uniformly distribute approximately 2/3 of required weight of dry shake material over concrete surface, and embed by means of power floating. Follow floating operation with second shake application, uniformly distributing remainder of dry shake material at right angles to first application, and embed by power floating.

After completion of broadcasting and floating, apply trowel finish as herein specified. Cure slab surface with curing compound recommended by dry shake hardener manufacturer, waiting up to time period as required by the

manufacturer (depending on humidity and drying) before application. Do not use moisture-cover or moisture curing methods.

3.7 CONCRETE FINISH MEASUREMENT AND TOLERANCES

A. Definitions:

1. Flatness - A measure of a concrete surfaces curvature or deviation from a planar surface. Concrete surfaces that are not flat are wavy or bumpy.
2. Levelness - A measure of a concrete surfaces tilt or inclination from a horizontal plane. Concrete surfaces that are not level are sloped or tilted.

B. Construction Requirements to Achieve Specified Floor Finish Tolerances:

1. Forms shall be properly leveled, in good condition and securely anchored including special attention to ends and transitions.
2. Bearing surfaces for straightedges such as form edges or previously poured slabs shall be kept clean of laitance, sand, gravel, or other foreign elements.
3. Screeds shall be maintained in good condition with true round rolling wheels and level cutting edges. The use of optical sighting equipment such as lasers is recommended for checking levelness and straightness. The Contractor shall promptly adjust or replace equipment when test results indicate substandard work.

C. Concrete Floor Finish Tolerance for Slab-on-Grade Construction:

1. Concrete Placement: Concrete shall be placed and screeded to predetermined marks set to elevations prescribed on the drawings.
2. Tolerance: Finished floor elevation shall not vary more than $\frac{1}{4}$ inch in 10 feet, non cumulative.

D. Remedial Measures for Slab Finish Construction Not Meeting Specified Tolerances:

1. Modification of Existing Surface:
 - a. If, in the opinion of the Architect/Engineer 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, then 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 to effect the repair.
 - c. Repair method(s), at the sole discretion of the Architect/Engineer or Owner's Representative, may include grinding (floor stoning),

planing, retopping with self leveling grout or polymer concrete, or any combination of the above.

- d. The Architect/Engineer or Owner's Representative maintains the right to require a test repair section using the approved method of repair for review and approval to demonstrate a satisfactory end product. If, in the opinion of the Architect/Engineer or Owner's Representative, the repair is not satisfactory an alternate method of repair shall be submitted or the defective area shall be replaced.
- e. The judgment of the Architect/Engineer or Owner's Representative on the appropriateness of a repair method and its ability to achieve the desired end product shall be final.
- f. All repair work shall be performed at no additional cost to the Owner and with no extension to the construction schedule.

2. 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, then the Contractor shall immediately commence to remove and replace the defective work.
- b. Replacement section boundaries shall be made to coincide with the test section boundaries as previously defined.
- c. Sections requiring replacement shall be removed by sawcutting along the section boundary lines to provide a neat clean joint between new replacement floor and existing floor.
- d. The new section shall be reinforced the same as the removed section and doweled into the existing floor as required by the Engineer. No existing removed reinforcing steel may be used. All reinforcing steel shall be new steel.
- e. Replacement sections may be retested for compliance at the discretion of the Architect/Engineer or Owner's Representative.
- f. The judgment of the Architect/Engineer or Owner's Representative on the need for replacement shall be final.
- g. All replacement work shall be performed at no additional cost to the Owner and with no extension to the construction schedule.

3.8 CONCRETE CURING AND PROTECTION

A. General:

1. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Maintain concrete with minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of concrete.
2. Curing shall commence as soon as free water has disappeared from the concrete surface after placing and finishing. The curing period shall be 7 days for all concrete except high early strength concrete, which shall be cured for 3 days minimum, unless test cylinders, made and kept adjacent to the structure and cured by the same methods, are tested with the average compressive strength equal to 70% of the specified 28 day strength. Curing may also be terminated when the temperature of the concrete is maintained at least 50°F for the same length of time that laboratory cured cylinders, representative of the concrete in place, require to achieve 85% of the 28 day compressive strength.
3. Curing shall be in accordance with ACI 301 procedures. Avoid rapid drying at the end of the curing period.

B. Curing Methods: Perform curing of all concrete horizontal and vertical surfaces (including columns, shear walls and basement walls) by one of the methods specified or by combinations thereof, as herein specified. The Contractor shall choose a curing method that is compatible with the requirements for subsequent material usage on the concrete surface. Parking garages shall be cured using only methods 1 or 2 below.

1. Provide moisture curing by one of the following methods:
 - a. Keep concrete surface continuously wet by covering with water.
 - b. Continuous water-fog spray.
 - c. Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.
2. Provide moisture-cover curing as follows: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Provide curing/hardener or liquid membrane forming curing compound to interior slabs with resilient flooring, carpet over cushion, or left exposed; and to exterior slabs, walks and curbs, as follows:

Apply specified compound to concrete slabs as soon as final finishing operations are complete (within 2 hours). Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Do not allow to puddle. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.

Do not use membrane curing compounds on surfaces which are to be covered with coating material applied directly to concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, flooring (such as ceramic or quarry tile, glue down carpet), painting and other coatings and finish materials, unless otherwise acceptable to the Architect.

Use only clear curing compounds for exposed interior slabs and all exterior concrete.

- C. Curing Formed Surfaces: Where wooden forms are used, cure formed concrete surfaces, including undersides of beams, supported slabs and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. When forms are removed, continue curing by methods specified above, as applicable.
- D. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping and other flat surfaces by application of appropriate curing compound.

Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture-retaining cover, unless otherwise directed.

3.9 HOT WEATHER CONCRETING

- A. Definition:
 - 1. Conditions warranting hot weather concreting practices are defined as any combination of high air temperature, low relative humidity and wind velocity tending to impair the quality of fresh or hardened concrete or otherwise result in abnormal properties.
 - 2. The maximum acceptable concrete temperature at the truck discharge point shall be 95°F.
- B. Specification: Hot weather concreting practices required to limit the concrete temperature at the truck discharge point to 95°F or lower shall be followed according to ACI 305 "Hot Weather Concreting."
- C. Records: Under hot weather conditions, the Contractor shall keep records of outside air temperature, concrete temperature at truck discharge and general weather conditions.
- D. Hot Weather Concreting Requirements: The following items, all or in part as required, should be followed to limit the concrete temperature to 95°F or lower:

1. Design the concrete mixes specifically for hot weather conditions replacing some cement with fly ash or other pozzolan and using a water reducing retarding admixture (ASTM C 494 Type D).
2. Use the largest size and amount of coarse aggregate compatible with the job.
3. Use sunshades and/or windbreaks.
4. Delay construction of indoor slabs-on-grade until the walls and roof are constructed.
5. Cool and shade aggregate stockpiles.
6. Use ice as part of the mixing water or cool the water with liquid nitrogen.
7. Limit the number of revolutions at mixing speed to 125 maximum.
8. Paint mixers and storage bins or silos white to minimize heat absorption.
9. Reduce time between mixing and placing as much as possible.
10. Do not add water to ready-mixed concrete at the job site unless it is part of the amount required initially for the specified water-cement ratio and the specified slump.
11. Schedule concrete placement for early morning, late afternoon, or night.
12. Have all forms, equipment and workers ready to receive and handle concrete.
13. Maintain one standby vibrator for every three vibrators used.
14. Keep all equipment cool by spraying with water including chutes, conveyors, pump lines, tremies, reinforcement and buggies.
15. Dampen the subgrade and side forms with cool water.
16. Protect slab concrete at all stages against undue evaporation by applying a fog spray or mist above the surface or applying a monomolecular film. Where high temperatures and/or placing conditions dictate, use water-reducing retarding admixture (Type D) in lieu of the water-reducing admixture (Type A) as directed by the Owner's Testing Laboratory.
17. Provide continuous curing, preferably with water, during the first 24 hours using wet burlap, cotton mats, continuous spray mist, or by applying a curing compound meeting ASTM C 309. Continue curing for 3 days minimum.
18. Spray exteriors of forms to keep them cool.
19. As soon as possible, loosen forms and run water down the inside. When forms are removed, provide a wet cover to newly exposed surfaces.

3.10 COLD WEATHER CONCRETING

A. Definition:

1. Concrete shall not be placed on any day when the outside air temperature is 40°F or less and falling unless cold weather concreting practices are followed as specified below.
2. Cold weather concreting practices should be followed whenever the mean daily temperature drops below 40°F for more than three successive days.
3. The temperature of concrete mixed and delivered to the job site shall conform to the following requirements:

Air Temperature

Min. Concrete Temperature

Above 30°F	60°F
0°F to 30°F	65°F
Below 0°F	70°F

4. The minimum temperature of concrete during placement and curing shall be 55°F. The maximum concrete temperature heated by artificial means at point of placement shall not exceed 90°F.
- B. Specification: Cold weather concreting practices required to limit the concrete temperatures as specified above shall be followed according to ACI 306R-78 "Cold Weather Concreting".
- C. Records: Under cold weather conditions, the Contractor shall keep records of outside air temperature, concrete temperature as placed and general weather conditions.
- D. Cold Weather Concreting Requirements: The following items, all or in part as required, should be followed to assure acceptable concrete in cold weather conditions:
1. Design the concrete mix suitable for cold weather. Use air entrainment and obtain high early strength by using a higher cement content, a high early strength cement (Type III), or an accelerator (ASTM C 494 Type C and E).
 2. Protect the concrete during curing period using insulating blankets, insulated forms, enclosures and/or heaters.
 3. Concrete cured in heated enclosures shall have heaters vented to prevent exposure of concrete and workmen to noxious gases.
 4. Frozen subgrade shall be thawed prior to concrete placement and snow and ice shall be removed from forms.
 5. Concrete shall be protected and cured at 55°F for three days minimum if normal concrete (Type I cement) is used and for two days minimum if high early strength concrete (concrete with Type III cement, 100 pounds cement added per cubic yard concrete, or an accelerator added).
 6. Concrete not loaded during construction shall be protected a minimum of 3 days for normal concrete and 2 days for high early strength concrete to obtain safe form stripping strength. Concrete fully loaded during construction shall be protected for whatever time period is required to obtain the required strength as determined by nondestructive strength tests (Windsor probe, Swiss Hammer Test) on the in-place concrete.
 7. Heat the mixing water and then blend hot and cold water to obtain concrete no more than 10°F above the required temperature.
 8. Heat the aggregates by circulating steam in pipes placed in the storage bins for air temperatures consistently below 32°F. When either water or aggregate is heated to over 140°F combine them in the mixer first to obtain a maximum temperature of the mixture not to exceed 140°F in order to prevent flash set of the concrete.
 9. Uniformly thaw aggregates far in advance of batching to prevent moisture variations in the stockpile.
 10. Cover warmed stockpiles with tarps to retain heat.

11. Place air entraining admixture in the batch after the water temperature has been reduced by mixing with cooler solid materials.
12. Use wind screens to protect concrete from rapid cooling.
13. Place vertical pump lines inside the building, if possible, for concrete being pumped.
14. Maintain artificial heat as low as possible to reduce temperature stresses during cooling.
15. Avoid water curing of concrete. Apply the required curing compound to unformed surfaces as soon as possible to prevent drying of concrete from heated enclosures.
16. Delay form stripping as long as possible to help prevent drying from heated enclosures and to reduce damage to formed surfaces caused by premature stripping.
17. Provide triple thickness of insulating materials at corners and edges vulnerable to freezing.
18. Wrap protruding reinforcing bars with insulation to avoid heat drain from the warm concrete.
19. Gradually reduce the heat at the end of the heating period to reduce likelihood of thermal shock.

3.11 MISCELLANEOUS CONCRETE ITEMS

- A. Filling-In: Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place and cure concrete as herein specified, to blend with inplace construction. Provide other miscellaneous concrete filling shown or required to complete work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and 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 to template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.

3.12 CONCRETE SURFACE REPAIRS

- A. Definition - Defective Areas:
 1. Formed Surfaces: Concrete surfaces requiring repairs shall include all honeycombs, rock pockets and voids exceeding 1/4" in any dimension, holes left by tie rods or bolts, cracks in excess of 0.01" and any other defects that affect the durability or structural integrity of the concrete.
 2. Unformed Surfaces: Concrete surfaces requiring repair shall include all surface defects such as crazing, cracks in excess of 0.01" wide or cracks which penetrate to reinforcement or through the member, popouts, spalling and honeycombs.

B. Classification:

1. **Structural Concrete Repair:** Major defective areas in concrete members that are load carrying (such as shear walls, beams, joists and slabs), are highly stressed, and are vital to the structural integrity of the structure shall require structural repairs. Structural concrete repairs shall be made using a two part epoxy bonder and/or epoxy mortar. Location of structural concrete repairs shall be determined by the Engineer.
2. **Cosmetic Concrete Repair:** Defective areas in concrete members that are non-load carrying and minor defective areas in load carrying concrete members shall require cosmetic concrete repair. Cosmetic concrete repairs may be made using a non-epoxy non-shrink patching mortar and bonding agent. The location of cosmetic concrete repair required shall be determined by the Engineer. Cosmetic concrete repair in exposed-to-view surfaces will require Architect's approval prior to patching operation.
3. **Slab Repairs:** High areas in concrete slabs shall be repaired by grinding after concrete has cured at least 14 days. Low areas shall be filled using self-leveling mortars. Repair of slab spalls and other surface defects shall be made using epoxy products as specified above and as determined by the Engineer.

3.13 QUALITY CONTROL TESTING DURING CONSTRUCTION

See Testing Laboratory Services section of these Specifications for concrete materials and cast-in-place concrete inspection and test requirements.

END OF SECTION 03 30 00

SECTION 03 31 00 - EPOXY RELATED WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of contract, including General and Supplementary Conditions and Division - 1 Specification Sections, apply to the work of this section.

1.2 SCOPE OF WORK

A. Installation of epoxy grouted dowels or reinforcing steel, and bonding fresh concrete to hardened concrete. Such work shall be done by the Contractor in strict conformance to these specifications.

1.3 QUALITY ASSURANCE

A. Applicable Standards

1. American Society for Testing and Materials (ASTM)

C881 Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete

2. American Concrete Institute (ACI)

ACI 503 R Use of Epoxy Compounds with Concrete

ACI 503.1 Standard Specification for Bonding, Hardened Concrete, Steel, Wood, Brick, and Other Materials to Hardened Concrete with a Multi-Component Epoxy Adhesive

ACI 503.2 Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive

ACI 503.3 Standard Specification for Producing a Skid-Resistant Surface on Concrete by the Use of Multi-Component Epoxy System

ACI 503.4 Standard Specification for Repairing Concrete with Epoxy Mortars

B. Manufacturer's Qualifications

Companies furnishing the epoxy materials shall have a proven track record of at least five years. Furthermore, they shall have in existence a program of training, certifying and supporting a nationally organized program of approved contractors. Evidence of this shall be made available to the Engineer/Architect upon request.

C. Contractor's Qualifications: Contractor performing the work shall be an approved contractor by the manufacturer furnishing the epoxy materials, and shall have no less than five years experience in the various types of epoxy related work required in this project. A notarized certification from the manufacturer attesting to the training shall be submitted to the Engineer/Architect along with the proposal to do the work.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR EPOXY MATERIALS:

- A. All epoxy material shall be new and manufactured within the shelf life limitations set forth by the manufacturer.
- B. Epoxy shall be a two-part epoxy adhesive material, and shall be of epichlorohydrin/amine type. Polysulphide epoxies are not acceptable.
- C. Epoxy used shall be insensitive to the presence of water and moisture, and shall be capable of application and of strength development even when applied to damp surfaces having a temperature of 40° or above.
- D. Epoxy used shall develop a minimum strength of 6310 psi in tension and 12000 psi in compression at the end of seven days.
- E. Epoxies used shall not deteriorate under approximately 200 freeze thaw cycles.
- F. Epoxies used shall be 100% solids without solvents.
- G. Bonding and strength characteristics of epoxies shall be stable when exposed to ultraviolet rays.

2.2 ADDITIONAL REQUIREMENTS FOR EPOXY MORTARS

- A. Epoxy mortar used for bonding, patching, and resurfacing, shall have the following additional properties:
 - 1. Epoxy mortar shall be non-sagging.
 - 2. Sand used in preparing mortar shall be graded oven dry quartzite and furnished in bags.
 - 3. The epoxy mortar patch material shall match the existing texture and color of exposed concrete without giving a blotchy appearance. A test patch shall be applied for approval prior to final acceptance of the mortar. Size of test patch shall be approximately equal to the size of the average mortar patch to be used on the project.

2.3 GENERAL REQUIREMENTS FOR POLYMER MODIFIED CEMENTITIOUS MORTARS:

- A. Mortar used for bonding, patching, and resurfacing in exposed or exterior environmental conditions with large cyclic temperature changes shall have the following properties:
 - 1. Mortar shall be non-sagging.
 - 2. Coefficient of thermal expansion shall be comparable with that of concrete (5.5×10^{-6} in/in/°F).
 - 3. Sand used in preparing mortar shall be graded oven dry quartzite furnished in bags.
 - 4. The mortar patch material shall match the existing texture and color of exposed concrete without giving a blotchy appearance. A test patch shall be applied for approval prior to final acceptance of the mortar. Size of test patch shall be approximately equal to the size of the average mortar patch to be used on the project.

PART 3 - EXECUTION

3.1 EPOXY MORTAR:

A. Applicator's Qualifications

1. Epoxy mortar repair work shall only be performed by contractors who have successfully used this process on at least three similar structural repairs of equal scope which have performed successfully for a minimum period of five years.
2. Only adequately trained and experienced personnel shall be used on the job.

B. Surface Preparation

1. Concrete surface to which the epoxy mortar is to be applied shall be exposed parent concrete free of loose and unsound materials. Surface preparation shall be done by abrasive blasting, waterblasting or as otherwise required by the manufacturer.
2. Necessary approvals shall be obtained by the Contractor from authorizing governmental or other agencies prior to abrasive blasting. Abrasive blasting operations shall comply with the requirements of OSHA and NIOSH (National Institute for Occupational Safety and Health) Standard PB-246-697.
3. Surfaces shall be free of any deleterious materials such as laitance, dust, dirt, and oil.
4. Any exposed reinforcing steel shall also be cleaned and be free of rust and other contaminants. Cleaning shall be accomplished by mechanical means. Use powered wire brushes in locations where reinforcing steel cannot be cleaned by abrasive-blasting or water-blasting. All exposed reinforcing steel shall be coated with a corrosion inhibiting product specified elsewhere in this specification prior to mortar application.
5. Prime the cleaned surface with primer as required by the manufacturer.

C. Concrete Surface Inspection

1. Ensure that the surface temperature is at least 40°F to permit wetting of concrete surface by epoxy coating.
2. The Contractor shall evaluate the moisture content of concrete surface receiving epoxy mortar. This shall be done by determining if moisture will collect at bond lines between concrete and epoxy mortar before epoxy has cured. Evaluate this by taping a piece of polyethylene sheet to the concrete. If moisture collects on underside of the polyethylene sheet before epoxy would cure, then allow concrete to dry sufficiently to prevent the possibility of moisture between old concrete and new epoxy.

D. Mortar Application

1. Condition epoxy compound components to a temperature between 65°-80°F unless otherwise recommended by the manufacturer. Epoxies beyond this range of temperature shall not be used.
2. Stir each of the two parts of epoxy separately before mixing. Then mix in a clean container free of contaminants.

3. Thoroughly blend epoxy components and sand with Jiffy mixers (made by The Jiffy Mixer Co., Irvine, California) to a uniform and homogenous mixture. Small batches of one quart or less may be mixed by spatulas, palette knives or similar devices.
4. Mixing should be accomplished well within the pot life of epoxy (three minutes when using Jiffy mixer or five minutes when mixed by hand) after allowing for time required for application.
5. Apply mortar by trowel or other means suitable for the consistency of the epoxy-sand mortar mix.
6. Build up the repair area in layers with mortar thicknesses within those specified by the manufacturer (1/4" maximum per layer).
7. Consolidate the mortar thoroughly to remove entrapped air.
8. Finish surface of mortar to match the texture and contours of existing concrete.
9. Allow mortar to cure in accordance to manufacturers recommendations.

E. Cleanup

1. Protect surfaces surrounding the work areas against spillage.
2. Epoxy and epoxy mortar spillages shall be cleaned before they set.
3. Cleanup all portions of the existing structure that are soiled or stained in the process of epoxy mortar repair work.

3.2 EPOXY GROUTED BOLTS, DOWELS OR REINFORCING STEEL:

A. Applicator's Qualifications

1. Epoxy grouting of bolts, dowels or reinforcing steel shall only be performed by contractors who have had successful experience on a minimum of three projects of similar scope.
2. Only adequately trained epoxy applicators shall be used on the job. Furnish current certificate of training on request.

B. Surface Preparation

1. All bolts, dowels and reinforcing bars shall be abrasive blasted no more than eight hours before the grouting. If evidence of oxidation exists on the surface, the bolts, reinforcing bars and dowels shall be recleaned. Blast-clean surfaces using Steel Structures Painting Council, Surface Preparation No. 6, to give a surface condition corresponding to ASa2, BSa2, CSa2 of SSPC Vis 1, depending on the initial surface condition of the steel surface. Prior to blast-cleaning, clean surfaces to conform to SSPC SP1, SP2, and SP3, as required.
2. All holes shall be clean of dust, debris, and contaminants. Use compressed air from an oil-and-water-free compressed air source prior to epoxy application.

C. Drilling Holes for Embedment

1. Use only rotary-percussion type drills for drilling holes.
2. Drills shall be fitted with bits having single tooth that produce large cuttings, and hollow stem drill rods that permit simultaneous blowing of compressed air providing immediate expulsion of the cuttings from the hole.
3. Do not cut through any reinforcing steel unless indicated otherwise on the drawings. Use small diameter exploratory holes to detect presence of reinforcing steel prior to drilling holes for grouting.
4. Core drilling equipment, and electric impact hammers or other tools which do not provide for immediate expulsion of the drill cuttings shall not be used.
5. Unless noted otherwise on the drawings, depth of hole used for embedding the bolts, bars or dowels shall be at least fifteen times their diameter.
6. Unless noted otherwise on the drawings, the center to center distance between the embedded bolts, bars or dowels shall be at least twelve times their diameter.
7. Unless noted otherwise on the drawings, the edge distance shall be at least six times the diameter of the bolt, bar or dowel.
8. Hole diameter shall normally be 1/4" larger than the outside diameter of the embedded item. In no case shall the hole diameter be 3/8" larger than the diameter of the embedded item.

D. Epoxy Application

1. Condition epoxy compound materials at a temperature between 65°-80°F unless otherwise recommended by the manufacturer. Epoxies beyond this range of temperature shall not be used.
2. Mix epoxy materials in a clean container free of contaminants.
3. Thoroughly blend epoxy components with mechanical mixers to a uniform and homogenous mixture. Mix small batches (up to 1 quart) by use of spatulas, palette knives, or similar devices. Take care to use proper proportions of the epoxy components when using small batches.
4. Mixing shall be accomplished well within the pot life of the epoxy after allowing for time required for application.
5. Partially fill the hole with epoxy. Then insert the bolt, dowel or reinforcing bar into the hole such that the resin material oozes out around the embedded item, ensuring complete contact. Twist the bolt, dowel or bar slightly as it is inserted in the hole to ensure complete contact.
6. As an alternative to inserting the embedded item after the epoxy is poured in the hole, the bolt, dowel, or bar may be positioned in the hole and filled up with epoxy by hand caulking guns or injected with an in-head mixing equipment. In either case, the nozzle shall be provided with a hose or tube of sufficient length to reach the bottom of the hole being filled.
7. Where the holes are horizontal or overhead, the opening shall be covered by a masking or a duct tape. Make a split in the tape and insert the epoxy injection tube through the split. Fill hole completely with epoxy and then insert the embedded item through the split tape. Amount of epoxy should be such that a small amount of

material oozes through the split. Twist the bolt, dowel or bar slightly as it is inserted in the hole to ensure complete contact.

8. Do not apply epoxy in the rain or in the presence of standing water.

E. Cleanup

1. Protect surfaces surrounding the work area against spillage.
2. Epoxy oozed out from the holes and spillages shall be cleaned before they become difficult to remove.
3. Cleanup whatever portions of the existing structure are soiled or stained in the process of grouting the bolts, dowels or reinforcing bars.

END OF SECTION 03 31 00

SECTION 04 20 00 – UNIT MASONRY

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

PART 1 - GENERAL

CODES & SPECIFICATIONS

- A. All concrete masonry construction shall conform to the requirements of the local building code and IBC 2018.

DESCRIPTION OF WORK

- A. Extent of each type of masonry work is indicated on the architectural and structural drawings and in schedules. Provide all labor, materials, equipment, and services necessary for and incidental to the installation of all masonry construction as indicated on the drawings and specified herein.
- B. Masonry construction includes non-reinforced brick, and reinforced and non-reinforced concrete masonry including concrete filled masonry beams. Accessories include, but are not necessarily limited to ties, horizontal and vertical reinforcement, anchors to the structure, and control joints.
- C. The masonry contractor shall install all accessory items that are required in the work and supplied by others, including: bolts, nailing blocks, inserts, anchors, flashing, lintels, expansion joints, conduits, etc.
- D. Types of masonry work required include:
1. Concrete unit masonry (CMU).
 2. Stone masonry.
 3. Reinforcement, anchorage and accessories.

QUALITY ASSURANCE

- A. Single Source Responsibility for Masonry Units:
1. Obtain exposed masonry units of uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from one manufacturer for each different product required for each continuous surface or visually related surfaces.
- B. Single Source Responsibility for Mortar Materials:
1. Obtain mortar ingredients of uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source and producer for each aggregate.

SUBMITTALS

- A. Product Data:

1. Submit manufacturer's product data for each type of masonry unit, accessory, and other manufactured products, including certifications that each type complies with specified requirements. Provide certification of pull-out strength of all masonry ties and anchors. Submit certification of compliance with required standards for all masonry units. Submit one sample each of all masonry accessories items.
 2. For each type of stone masonry work, furnish not less than five individual stones as samples, showing extreme variations in color and texture.
- B. Samples for Initial Selection Purposes:
1. Submit samples of the following materials:
 - a. Unit masonry samples in small scale form showing full extent of colors and textures available for each type of exposed masonry unit required.
 - b. Colored masonry mortar samples showing full extent of colors available.
- C. Samples for Verification Purposes:
1. Submit the following samples:
 - a. Unit masonry samples for each type of exposed masonry unit required; include in each set the full range of exposed color and texture to be expected in completed work. Architect has samples that they will be matched against.
 - b. Include size variation data verifying that actual range of sizes for brick falls within ASTM C 216 dimension tolerances for brick where modular dimensioning is indicated.
 - c. Include size variation data verifying that actual range of sizes for stone matches existing masonry where indicated.
 2. For full size mock-up Reference Mock-up requirements in section 01 45 00 Quality Control.
- D. Mix Designs:
1. Mix designs for mortar and grout specifying type, source, and brand of all materials shall be submitted for Engineer and Owner testing laboratory approval prior to start of the work. Mix designs shall be submitted only for structural load bearing walls and exterior walls subjected to wind load.
- E. Results of Preconstruction Testing:
1. Test reports for each type of building and facing brick are to be submitted to the Architect/Engineer for approval.
 2. Testing and reports are to be completed by an independent laboratory.
 3. Test reports shall show:
 - a. Compressive strength
 - b. 24-hr. cold water absorption
 - c. 5-hr. boil absorption

- d. Saturation coefficient
- e. Initial rate of absorption (suction).

F. Certificates:

1. Prior to delivery, submit to Architect/Engineer certificates attesting compliance with the applicable specifications for grades, types or classes included in these specifications.

DELIVERY, STORAGE & HANDLING

- A. Deliver masonry materials to project in undamaged condition.
- B. Store and handle masonry units to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion or other causes.
- C. Limit moisture absorption of concrete masonry units during delivery and until time of installation to the maximum percentage specified for Type I units for the average annual relative humidity as reported by the U.S. Weather Bureau Station nearest project site.
- D. Store cementitious materials and masonry units off the ground, under cover and in dry location. All materials must be protected from wetting by capillary action, rain, or snow, and protected from mud, dust, or other materials and contaminants likely to cause staining or defects.
- E. Store aggregates where grading and other required characteristics can be maintained.
- F. Store masonry accessories including metal items to prevent deterioration by corrosion or accumulation of dirt.
- G. Store mortar materials on dunnage, in a dry place. During freezing weather, protect masonry units with tarpaulins or other suitable material.
- H. Protect reinforcement and accessories from elements.

PROJECT CONDITIONS

A. Protection of Work:

1. The Contractor shall construct and maintain temporary protection as required to permit continuous progress of the work. During erection, cover top of walls with waterproof sheeting at end of each day's work. Cover partially completed structures when work is not in progress.
 - a. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
 - b. Do not apply uniform floor or roof loading for at least 12 hours after building masonry walls or columns.
 - c. Do not apply concentrated loads for at least 3 days after building masonry walls or columns.

PART 2 - PRODUCTS

STONE

A. General:

1. Refer to Section 04 85 20 Natural Veneer Stone.

CONCRETE MASONRY UNITS

A. Comply with referenced standards and other requirements indicated below applicable to each form of concrete masonry unit required.

B. Provide square-edged units for outside corners, except where indicated as Bullnose.

C. Provide units complying with characteristics indicated below for Grade, Type, face size, exposed face and, under each form of block included, for weight classification.

1. Grade N.

2. Size:

- a. Manufacturer's standard units with nominal face dimensions of 16" long x 8" high (15-5/8" x 7-5/8" actual) x thicknesses indicated unless shown otherwise on the drawings. The Contractor shall furnish all required sizes and shapes as required to complete the work.

3. Type I, moisture-controlled units. Cure units by autoclave treatment at a minimum temperature of 350°F (176°C) and a minimum pressure of 125 psi.

4. Exposed Faces:

- a. Manufacturer's standard color and texture, unless otherwise indicated.

- 1) Where special finishes are indicated, provide units with exposed faces of the following general description matching color and texture of Architect's sample.

- (i) Standard aggregate, ground finish.

- 2) Where special patterns are indicated, provide units with exposed faces matching color, texture and pattern of Architect's sample.

5. Hollow Loadbearing Block:

- a. ASTM C 90 lightweight.

6. Solid Loadbearing Block:

- a. ASTM C 145 lightweight.

MORTAR & GROUT MATERIALS

A. Portland Cement:

1. ASTM C 150, Type I, except Type III may be used for cold weather construction. Provide natural color or white cement as required to produce required mortar color.

B. Hydrated Lime:

1. ASTM C 207, Type S.

C. Quicklime:

1. ASTM C5.

D. Aggregate for Mortar:

1. ASTM C 144, except for joints less than 1/4" use aggregate graded with 100% passing the No. 16 sieve.
 - a. White Mortar Aggregates: Natural white sand or ground white stone.

E. Coarse Aggregate for Grout:

1. ASTM C 404, maximum size 3/8".

F. Water:

1. Clean and potable. Mixing water must be free of harmful amounts of acids, alkalis, organic materials, or other substances that would adversely affect the quality or appearance of the mortar or the masonry units.

G. Proprietary Mortar Mixes:

1. Proprietary mortar mixes may not be used.

JOINT REINFORCEMENT, TIES & ANCHORING DEVICES

A. General:

1. Comply with requirements indicated below for basic materials and with requirements indicated under each form of joint reinforcement, tie and anchor for size and other characteristics:
2. Manufacturers:
 - a. Subject to compliance with requirements, provide products of one of the following:
 - (i) AA Wire Products Co.
 - (ii) Dur-O-Wall, Inc.
 - (iii) Hohmann & Barnard, Inc.
 - (iv) National Wire Products Corp.
 - b. Other manufacturers shall be used only with Engineer approval. The Contractor shall submit technical literature for all reinforcing units.

B. Hot-Dip Galvanized Steel Wire:

1. ASTM A 82 for uncoated wire and ASTM A 153, Class B-2 (1.5 oz. per sq. ft. of wire surface) for zinc coating applied after prefabrication into units.
 - a. Application: Use for masonry exposed to exterior and in contact with earth.

C. Zinc-Coated (Galvanized) Steel Sheet:

1. Carbon steel with zinc coating complying with ASTM A 525, Coating Designation G90.
 - a. Application: Use for dovetail slots and where indicated.

D. Hot-Dip Galvanized Carbon Steel Sheet:

1. ASTM A 366, Class 2 or ASTM A 635; hot-dip galvanized after fabrication to comply with ASTM A 153, Class B.
 - a. Application: Use for anchors.

E. Joint Reinforcement:

1. Provide welded-wire units prefabricated with deformed continuous side rods and plain cross rods in straight lengths of not less than 10 feet, with prefabricated corner and tee units, and complying with requirements indicated below:
 - a. Width: Fabricate joint reinforcement in units with widths a minimum of 2" less than nominal width of walls. Provide mortar coverage over joint reinforcement of not less than 5/8" on joint faces exposed to exterior and 1/2" elsewhere.
2. Wire Size for Side and Cross Rods:
 - a. 0.1483" diameter (9 ga.) for all masonry construction except as noted below.
 - b. 0.1875" diameter (6 ga.) for loadbearing or reinforced concrete masonry construction.
3. For single-wythe masonry provide type as follows with single pair of side rods:
 - a. Ladder design with perpendicular cross rods spaced not more than 16" o.c.

F. Bent-Wire Ties:

1. Provide individual prefabricated bent-wire units complying with requirements indicated below:
 - a. Wire Size: 0.1875" diameter.
 - b. Length: Provide units of length indicated but not less than that required for embedment into each wythe of 2" for solid units and for a minimum of 2" embedment of tie end into face shells of hollow units, with not less than 5/8" mortar cover on exterior face joints, 1/2" elsewhere.

- c. Tie Shape for Hollow Masonry Units Laid with Cells Vertical: Rectangular with ends welded closed and not less than 2" wide.
- d. Tie Shape for Solid Masonry Unit Construction: Z-shaped ties with ends bent 90° to provide hooks not less than 2" long.
- e. Type for Masonry where Coursing Between Wythes Align: Unit ties bent from one piece of wire.
- f. Type for Masonry where Coursing Between Wythes Does Not Align:
 - (i) Adjustable ties composed of two parts, one with a pintle, the other with an eye.

G. Flexible Anchors:

- 1. Where flexible anchors are indicated for connecting masonry to structural framework, provide 2-piece anchors as described below which permit vertical or horizontal differential movement between wall and framework parallel to, but resist tension and compression forces perpendicular to, plane of wall:
 - a. For anchorage to concrete framework, provide manufacturer's standard anchors with dovetail anchor section formed from 0.1046" (12 gage) thick sheet metal and triangular-shaped wire tie section sized to extend within 1" of masonry face.
 - b. For anchorage to steel framework provide manufacturer's standard anchors with crimped 1/4" diameter wire anchor section for welding to steel and triangular-shaped wire tie section sized to extend within 1" of masonry face.
 - c. Wire Size: 0.1875" diameter.

H. Masonry Veneer Anchors:

- 1. Provide individual prefabricated bent-wire units complying with requirements indicated below:
 - a. Wire Size: 0.1875" diameter.
 - b. Length: Provide units of length indicated but not less than that required for embedment into each wythe of 2" for solid units and for a minimum of 2" embedment of tie end into face shells of hollow units, with not less than 5/8" mortar cover on exterior face joints, 1/2" elsewhere.
 - c. Tie Shape for Brick Veneer to CMU backup: Z-shaped ties with ends bent 90° to provide hooks not less than 2" long.

I. Rigid Anchors:

- 1. Provide straps of form and length indicated, fabricated from sheet metal strips of following width and thickness, unless otherwise indicated. Typical length to be 24" plus 2" long, 90° bends at ends.
 - a. Width: 1-1/4"
 - b. Thickness: 1/4"

J. Unit Type Masonry Inserts in Concrete:

- 1. Furnish cast iron or malleable iron inserts of type and size indicated.

K. Dovetail Slots:

1. Furnish dovetail slots, with filler strips, of slot size indicated, fabricated from 0.0336" (22 gage) sheet metal.

L. Anchor Bolts:

1. Provide steel bolts with hex nuts and flat washers complying with ASTM A 307, Grade A, hot-dip galvanized to comply with ASTM C 153, Class C, in sizes and configurations indicated.

CONCEALED FLASHING MATERIALS

A. Sheet Metal Flashing:

1. Fabricate from the following metal complying with requirements specified in 075416 - Ketone Ethylene Ester (KEE) Based Sheet Roofing, 076200 sheet metal flashing and trim and below:
 - a. Stainless Steel: 0.015" thick.
2. Fabricate through-wall metal flashings with deformation in both directions for integral mechanical mortar bond.

B. Membrane Flashing:

1. Refer to Section 076500 - Flexible Flashing Self-adhering

MISCELLANEOUS MASONRY ACCESSORIES

A. Weepholes:

Louvered or Honeycomb polypropylene design to allow passage of moisture from cavity to the building. Size vents to fit head joints of brick or block being used.

1. Basis of Design: QV - Quadro-Vent by Hohmann and Barnard, Inc.
2. Color: Grey where uncolored mortar is used. As selected by Architect from manufacturer's full line of colors when colored mortar is used.

B. Cavity Drainage Material:

High density polyethylene strands woven into a 90% open mesh that breaks up mortar droppings and prohibits mortar from creating a moisture retaining barrier, allowing water to flow freely to the weep holes.

1. Basis of Design: Mortar Trap by Hohmann and Barnard, Inc.

C. Bond Breaker Strips:

Asphalt-saturated organic roofing felt complying with ASTM D 226, Type I (No.15 asphalt felt).

MASONRY CLEANERS & SEALERS

A. Job-Mixed Detergent Cleaning Solution:

1. Solution of trisodium phosphate (1/2 cup dry measure) and laundry detergent (1/2 cup dry measure) dissolved in one gallon of water.

B. Brick Sealer and Stone Sealer:

1. Refer to section 07 19 16 Water Repellent.

MORTAR & GROUT MIXES

A. General:

1. Do not add admixtures including coloring pigments, air-entraining agent, accelerators, retarders, water repellent agent, anti-freeze compounds or other admixtures.
2. Do not use calcium chloride in mortar or grout.

B. Mortar for Unit Masonry:

1. Comply with ASTM C 270, Proportion Specification, for types of mortar required, unless otherwise indicated. Minimum twenty-eight day compressive strength shall be 1800 psi.
 - a. Limit cementitious materials in mortar to portland cement-lime.
 - b. Use Type S mortar for reinforced masonry unless noted otherwise.

C. Colored Pigmented Mortar:

1. Select and proportion pigments with other ingredients to produce color required. Do not exceed pigment-to-cement ration of 1-to-10, by weight.

D. Grout for Unit Masonry:

1. Comply with ASTM C 476 for grout for use in construction of reinforced and non-reinforced unit masonry. Use grout of consistency indicated or if not otherwise indicated, of consistency (fine or coarse) at time of placement which will completely fill all spaces intended to receive grout. Minimum twenty-eight day compressive strength shall be 2000 psi.
2. Use fine grout in grout spaces less than 2" in horizontal direction, unless otherwise indicated. Fine grout shall be composed of one-part portland cement, to which may be added not more than one-tenth part hydrated lime or lime putty, and two and one-fourth to three parts sand.
3. Use coarse grout in grout spaces 2" or more in least horizontal dimension, unless otherwise indicated. Coarse grout shall be composed of one-part portland cement to which may be added not more than one-tenth part hydrated lime or lime putty, and two to three parts sand, and not more than two parts gravel.
4. Satisfy all local codes for maximum aggregate size with respect to minimum clear opening to be grouted.

PART 3 - EXECUTION

INSTALLATION - GENERAL

- A. Inspect surfaces that are to support masonry work to assure completion to proper lines and grades free of dirt and other deleterious material. Do not begin work until surfaces not properly prepared have been satisfactorily corrected.
- B. Wetting Clay Brick:
1. Wet brick made from clay or shale which have ASTM C 76 initial rates of absorption (suction) of more than 20 grams for 30 sq. in. per minute. Use wetting methods which ensure each clay masonry unit being nearly saturated with clean water 24 hours prior to placement but surface dry when laid.
 - a. For clay masonry units with initial rates of absorption (suction) which require them to be wetted before laying, comply with the following requirements:
 - (i) For units with surface temperatures above 32°F (0°C), wet with water heated to above 70°F (21°C).
 - (ii) For units with surface temperatures below 32°F (0°C), wet with water heated to above 130°F (54°C).
 - (iii) During freezing weather, units that require wetting shall be sprinkled with warm or hot water just before laying.
 2. Do not wet concrete masonry units.
- C. Cleaning Reinforcing:
1. Before placing, remove loose rust, ice and other coatings from reinforcing.
- D. Thickness:
1. Build cavity and composite walls, floors and other masonry construction to the full thickness shown. Build single-wythe walls (if any) to the actual thickness of the masonry units, using units of nominal thickness indicated.
 2. Build chases and recesses as shown or required for the work of other trades. Provide not less than 8" of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses.
 3. Leave openings for equipment to be installed before completion of masonry work. After installation of equipment, complete masonry work to match work immediately adjacent to the opening.
- E. Cutting masonry units:
1. Cut masonry units using motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous patterns and to fit adjoining work. Use full-size units without cutting where possible.
 2. Use dry cutting saws to cut concrete masonry units.

- F. Do not install cracked, broken, or chipped masonry units exceeding ASTM allowances.
- G. Protect sills, ledges, and offsets from mortar droppings or other damage during construction. Protect base of walls from rain-splashed mud and mortar splatter by means of coverings spread on ground and over wall surface. Remove misplaced mortar or grout immediately. Protect face materials against staining. Protect door jambs and corners from damage during construction.
- H. Prevent grout or mortar or soil from staining the face of masonry to be left exposed or painted. Immediately remove grout or mortar in contact with such masonry.
- I. Mixing Mortar and Grout:
 - 1. Combine and thoroughly mix cementitious material and aggregate for a minimum of five (5) minutes in a mechanical batch mixer. Add water in amounts required for workability. If mortar begins to stiffen from evaporation or absorption of a part of mixing water, retemper by adding water and remix. Grout shall have a slump of ten and one-half (10 1/2) to eleven (11) inches at time of placement. Mortar and grout shall be used within two and one-half (2 1/2) hours of initial mixing and no mortar or grout shall be used after it has begun to set.

COLD WEATHER CONSTRUCTION

A. Surface Conditions:

- 1. Ice or snow that has formed on the masonry bed shall be thawed by application of heat. Apply heat carefully until top surface is dry to the touch. Any section of completed masonry work that is deemed frozen and damaged shall be removed before continuing construction of that section.

B. Perform the following construction procedures while masonry work is progressing. Temperature ranges indicated below apply to air temperatures existing at time of installation except for grout. For grout, temperature ranges apply to anticipated minimum night temperatures. In heating mortar and grout materials, maintain mixing temperature selected within 10°F (6°C).

1. 40°F (4°C) to 32°F (0°C):

- a. Mortar: Heat mixing water to produce mortar temperature between 40°F (4°C) and 120°F (49°C).
- b. Grout: Follow normal masonry procedures.

2. 32°F (0°C) to 25°F (-4°C):

- a. Mortar: Heat mixing water and sand to produce mortar temperatures between 40°F (4°C) and 120°F (49°C); maintain temperature of mortar on boards above freezing.
- b. Grout: Heat grout materials to 90°F (32°C) to produce in place grout temperature of 70°F (21°C) at end of work day.

3. 25°F (-4°C) to 20°F (-7°C):
 - a. Mortar: Heat mixing water and sand to produce mortar temperatures between 40°F (4°C) and 120°F (49°C); maintain temperature of mortar on boards above freezing.
 - b. Grout: Heat grout materials to 90°F (32°C) to produce in place grout temperature of 70°F (21°C) at end of work day.
 - c. Heat both sides of walls under construction using salamanders or other heat conventionally used and effective sources.
 - d. Use windbreaks or enclosures when wind is in excess of 15 mph.
 4. 20°F (-7°C) and below:
 - a. Mortar: Heat mixing water and sand to produce mortar temperatures between 40°F (4°C) and 120°F (49°C).
 - b. Grout: Heat grout materials to 90°F (32°C) to produce in place grout temperature of 70°F (21°C) at end of work day.
 - c. Masonry Units: Heat masonry units so that they are above 32°F (0°C) at time of laying.
 - d. Provide enclosure and auxiliary heat to maintain an air temperature of at least 40°F (4°C) for 24 hours after laying units.
 5. Do not heat water for mortar and grout to above 160°F (71°C).
- C. Protect completed masonry and masonry not being worked on in the following manner. Temperature ranges indicated apply to mean daily air temperatures except for grouted masonry. For grouted masonry, temperature ranges apply to anticipated minimum night temperatures.
1. 40°F (4°C) to 32°F (0°C): Protect masonry from rain or snow for at least 24 hours by covering with weather-resistive membrane.
 2. 32°F (0°C) to 25°F (-4°C): Completely cover masonry with weather-resistive membrane for at least 24 hours.
 3. 25°F (-4°C) to 20°F (-7°C): Completely cover masonry with weather-resistive insulating blankets or similar protection for at least 24 hours, 48 hours for grouted masonry.
 4. 20°F (-7°C) and below: Except as otherwise indicated, maintain masonry temperature above 32°F (0°C) for 24 hours using enclosures and supplementary heat, electric heating blankets, infrared lamps or other methods proven to be satisfactory. For grouted masonry maintain heated enclosure to 40°F (4°C) for 48 hours.

CONSTRUCTION TOLERANCES

A. Variation from Plumb:

1. For vertical lines and surfaces of columns, walls and arises do not exceed 1/4" in 10 feet, or 3/8" in a story height not to exceed 20 feet, nor 1/2" in 40 feet or more. For external corners, expansion joints, control joints and other conspicuous lines, do not exceed 1/4" in any story or 20 feet maximum, nor 1/2" in 40 feet or more. For vertical alignment of head joints do not exceed plus or minus 1/4" in 10 feet, 1/2" maximum.

B. Variation from Level:

1. For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines, do not exceed 1/4" in any bay or 20 feet maximum, nor 1/2" in 40 feet or more. For top surface of bearing walls do not exceed 1/8" between adjacent floor elements in 10 feet or 1/16" within width of a single unit.

C. Variation of Linear Building Line:

1. For position shown in plan and related portion of columns, walls and partitions, do not exceed 1/2" in any bay or 20 feet maximum, nor 3/4" in 40 feet or more.

D. Variation in Cross-Sectional Dimensions:

1. For columns and thickness of walls, from dimensions shown, do not exceed minus 1/4" nor plus 1/2".

E. Variation in Mortar Joint Thickness:

1. Do not exceed bed joint thickness indicated by more than plus or minus 1/8", with a maximum thickness limited to 1/2". Do not exceed head joint thickness indicated by more than plus or minus 1/8".

LAYING MASONRY WALLS

A. Layout walls in advance for accurate spacing of surface bond patterns with uniform joint widths and to accurately locate openings, movement-type joints, returns and offsets. Avoid the use of less-than-half-size units at corners, jambs and wherever possible at other locations.

B. Lay-up walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other work.

C. Pattern Bond:

1. Lay exposed masonry in the bond pattern shown or, if not shown, lay in 1/2 running bond with vertical joint in each course centered on units in courses above and below. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2". Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4" horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work:

1. Rack back 1/2-unit length in each course; do not tooth. Clean exposed surfaces at set masonry, wet units lightly (if required) and remove loose masonry units and mortar prior to laying fresh masonry.

E. Built-in Work:

1. Install bolts, anchors, nailing blocks, inserts, frames, vent flashings, conduit, and other built-in items specified under this and other sections of these specifications as masonry

work progresses. Avoid cutting and patching. Solidly grout spaces around built-in items. Provide joints around exterior framed openings 1/4" to 3/8" wide, raked and tooled smooth to a uniform depth of 3/4", ready for caulking by others. Build chases, do not cut. Consult other trades in advance and make provisions for installation of their work to avoid cutting and patching. Install chases minimum of one full masonry unit length from jambs.

- a. Fill in space between hollow metal frames and masonry solidly with mortar, unless otherwise indicated.
- b. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core, unless detailed otherwise.
- c. Fill cores in hollow concrete masonry units with grout to supporting beam or slab below under bearing plates, beams, lintels, posts and similar items, unless otherwise indicated.

F. Bondbreaker Strips at Corners:

1. Unless shown otherwise, provide bondbreaker strips between concrete foundation and first masonry course for a length of 3 feet each direction from all corners.

MORTAR BEDDING & JOINTING

A. Provide uniform nominal joint thickness as shown below, unless noted otherwise on the drawings:

1. Concrete Masonry Units & Brick, 3/8".

B. Lay solid brick size masonry units and hollow CMU with cells grouted with completely filled bed and head joint; butter ends with sufficient mortar to fill head joints and shove into place. Do not furrow bed joints. Do not slush head joints.

C. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course on footings and in all courses of piers, columns and pilasters, and where adjacent to cells of cavities to be reinforced or filled with concrete or grout. For starting course on footings where cells are not grouted, spread out full mortar bed including areas under cells.

D. Maintain joint widths shown, except for minor variations required to maintain bond alignment. If not shown, lay walls with 3/8" joints.

E. Provide weather-proof, concave, tooled joints in exposed surfaces when mortar is thumbprint hard, using round jointing tool. Strike joints flush in surfaces to be plastered, stuccoed, or covered with other material or surface-applied finish other than paint. Concave tool exterior joints below grade. Remove mortar protruding into cells or cavities to be grouted. Do not permit mortar droppings to fall into cavities of multi-wythe walls or to block weep holes. Do not fill horizontal joints between top of masonry partitions and underside of concrete or steel construction with mortar unless specifically shown on the drawings. If not shown otherwise, provide 1" clear joint to be filled with caulk. Keep movement joints clean of all mortar and debris. For tuckpointing, rake mortar joints to a depth of 1/2 to 3/4 in., saturate with clean water, fill solidly with pointing mortar, and tool to match existing joints.

F. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners of jambs to shift adjacent stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.

G. Collar Joints:

1. After each course is laid, fill the vertical longitudinal joint between wythes solidly with mortar (grout if walls are grouted) for the following masonry work:
 - a. Exterior walls, except cavity walls.

STRUCTURAL BONDING OF MULTI-WYTHE MASONRY

A. Where horizontal joints in adjacent wythes do not align use individual metal ties installed in horizontal joints to bond wythes together. Provide ties as shown, but not less than one metal tie for 2.0 square feet of wall and spaced not to exceed 24" o.c. horizontally or vertically. Stagger ties in alternate courses. Provide additional ties within 1'-0" of all openings and space not more than 3'-0" apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24" o.c. vertically.

MAX. TIE SPACING

VERT.	HORIZ.
24"	16"

- B. Bed joints of opposing wythes shall not be farther apart vertically than 1 1/2" either direction. Ties shall be sized to extend a minimum of 2" into the joints.
- C. Where horizontal joints of adjacent wythes align, use continuous horizontal joint reinforcement installed in horizontal mortar joints for bond tie between wythes. Install at not more than 16" o.c. vertically.

D. Corners:

Provide interlocking masonry unit bond in each course at corners, unless otherwise shown.

1. For horizontally reinforced masonry, provide continuity at corners with prefabricated "L" units, in addition to masonry bonding.

E. Intersecting and Abutting Walls:

Unless vertical expansion or control joints are shown at juncture, provide same type of bonding specified for structural bonding between wythes and space as follows:

1. Provide individual metal ties at not more than 24" o.c. vertically.
2. Provide continuity with horizontal joint reinforcement using prefabricated "T" units.

F. Non-bearing Interior Partitions:

Build full height of story to underside of solid floor or roof structure above, unless otherwise shown.

CAVITY WALLS

- A. Keep cavity clean of mortar droppings and other materials during construction. Strike joints facing cavity flush.
- B. Where horizontal joints of adjacent wythes align, tie exterior wythe to back-up with continuous horizontal joint reinforcing, installed in mortar joints at not more than 16" o.c. vertically.
- C. Where horizontal joints of adjacent wythes do not align, tie exterior wythe to back-up with individual metal ties spaced not more than 24" o.c. vertically and 16" o.c. horizontally. Stagger courses with joint reinforcing.
- D. Provide weep holes in head joints in first course immediately above all flashing. Leave head joint free and clean of mortar. Space weep holes 24" on center maximum for brick masonry, and 32" on center maximum for concrete unit masonry. Keep weep holes and area above flashing free of mortar droppings.

HORIZONTAL JOINT REINFORCEMENT

A. General:

- 1. Provide continuous horizontal joint reinforcement as indicated. Install longitudinal side rods in mortar for their entire length with a minimum cover of 5/8" on exterior side of walls, 1/2" elsewhere. Lap reinforcing a minimum of 6" at splices.
- 2. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
- 3. Reinforce walls with continuous horizontal joint reinforcing unless specifically noted to be omitted.
- 4. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend reinforcement units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.
- 5. Space continuous horizontal reinforcement as follows:
 - a. For multi-wythe walls (solid or cavity) space horizontal reinforcement 8" o.c. vertically for first two courses then 16" o.c. vertically.
 - b. For single-wythe walls space horizontal reinforcement 8" o.c. vertically for first two courses then 16" o.c. vertically.
 - c. For parapets, space reinforcement at 8" o.c. vertically, unless otherwise indicated.
 - d. For perforated masonry screen walls, space reinforcement at 12" o.c. vertically, unless otherwise indicated.
 - e. For concrete masonry cantilever walls and fences, space reinforcement at 8" o.c. vertically, unless otherwise indicated.
- 6. Reinforce masonry openings greater than 1'-0" wide, with horizontal joint reinforcement placed in two horizontal joints approximately 8" apart, immediately above the lintel and immediately below the sill. Extend reinforcement a minimum of 2'-0" beyond jambs of the opening except at control joints. Horizontal joint reinforcement interrupted by the jamb of

an opening shall have the cross rod or side rod bent and hooked at the jamb. Provide an additional rectangular adjustable tie at the jamb for each joint not containing the normal horizontal reinforcing unit.

7. Provide reinforcement at openings in addition to other specified wall reinforcement.

ANCHORING MASONRY VENEER

A. General:

1. Provide anchor devices of type indicated.

B. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following, unless noted otherwise on the drawings:

1. Provide an open space not less than 1" in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar or other rigid materials.
2. Anchor masonry to structural members with flexible anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24" o.c. vertically and 16" o.c. horizontally.

C. Where wire ties are welded to structural members, paint welded area with Z.R.C. Cold Galvanizing Compound after welding.

D. Anchor single wythe masonry veneer to CMU back up walls with adjustable masonry veneer anchors to comply with the following requirements:

1. Install ladder or truss type horizontal joint reinforcing in the CMU wall. Locate joint reinforcement in the first bed joint and at 16" centers vertically above that.
2. Tie masonry veneer to CMU wall with rigid Z wire ties as specified. Provide one wall tie for each 2.66 square feet of wall area.
3. Maximum spacing shall be 24" vertically and 16" horizontally.
4. Place wall ties in alternate courses from CMU wall horizontal reinforcing.
5. Bed joints of opposing wythes with ties shall not be farther apart vertically than 1 1/2" either direction.
6. Ties shall extend a minimum of 2" into brick and CMU joints.

GROUTING

- ### **A. Where detailed, grout in reinforced masonry walls, columns, and pilasters as specified below. Fully grout vertical cells of concrete masonry containing steel reinforcement. Wherever possible, grouting shall be done from inside face of masonry. Exercise extreme care to prevent grout from staining face of masonry. Immediately remove any spilled grout from face and top of masonry.**

CONTROL & EXPANSION JOINTS

A. General:

1. Provide vertical and horizontal expansion, control and isolation joints in masonry where shown. Build-in related items as the masonry work progresses.

B. Where control joints are not indicated on the drawings the Contractor shall submit a proposed control joint layout for Architect and Engineer approval. General guidelines for control joint locations are as follows:

1. At major changes in wall height
2. At changes in wall thickness
3. At corresponding control joints in foundations, floor, or roof construction
4. At one or both sides of wall openings (masonry veneer only)
5. Near wall intersections
6. At column centerlines.

C. Maximum Spacing:

Maximum control joint spacing shall be as follows:

1. Non-Reinforced Masonry. Ratio of wall length to height shall not exceed 3 with maximum spacing of fifty feet.
2. Reinforced Masonry. Ratio of wall length to height shall not exceed 4 with a maximum spacing of 100 feet.

D. Build-in non-metallic joint fillers where indicated.

E. Provide continuous bond break at steel columns and members.

F. Provide pressure-relieving joints by adhering a continuous 3/8" thick neoprene pad below shelf angles supporting masonry veneer.

G. Leave joints around outside perimeters of exterior doors, window frames and other wall openings:

1. Depth: Uniform 3/4 in. (19mm).
2. Width: 1/4 in. (6.4 mm) to 3/8 in. (9.5mm).

LINTELS

A. Install steel lintels where indicated.

- B. Provide masonry lintels where shown and wherever openings of more than 1'-0" for stone size units and 2'-0" for block size units are shown without structural steel or other supporting lintels. Provide precast or formed-in-place masonry lintels. Cure precast lintels before handling and installation. Temporarily support formed-in-place lintels until grout is properly cured.
 - 1. For hollow concrete masonry unit walls, use specially formed U-shaped lintel units with reinforcement bars placed as shown filled with coarse grout.
- C. Provide minimum bearing of 8" at each jamb, unless otherwise indicated.

FORMS & SHORES

- A. Provide forms and shores sufficiently strong and rigid as required to support brick soffits, beams, and lintels during construction.
- B. Build forms to conform to shape, line, and dimension of masonry members as detailed, substantial and sufficiently tight to prevent leakage of mortar, grout or concrete. Properly brace or tie together so as to maintain position and shape.
- C. Provide joint strips on form face of soffit forms at each brick joint.

FLASHING OF MASONRY WORK

- A. Refer to Section 072720 - Fluid Applied Air Barrier, Section 076200 - Sheet Metal Flashing And Trim and Section 076500 - Flexible Flashing Self-Adhering.

INSTALLATION OF REINFORCED UNIT MASONRY

- A. Refer to Section 04 20 00.13 "Reinforced Unit Masonry" for installation requirements applicable to reinforced unit masonry.

FIELD QUALITY CONTROL

- A. Owner will employ separate testing laboratory to perform field quality control testing.
- B. Prism Test Method:
 - 1. Compression Test: For each type of wall construction indicated for testing, test representative masonry prisms by methods of sampling and testing of ASTM E 447, Method B, and as follows:
 - a. Prepare one set of three prisms for testing at 7 days and one set of three prisms for testing at 28 days.
 - b. For brick and concrete masonry prisms adhere to requirements as specified under preconstruction testing. Build prisms on job using same materials and methods as for wall construction. Store prisms in air at temperature not less than 65°F in a place where they will be undisturbed for seven (7) days. After seven (7) days, transport to laboratory in a manner which will not disturb mortar bond.
 - c. Cap each prism with suitable material to provide bearing surfaces on each end.

- (i) Plane within 0.003 inch
 - (ii) Approximately perpendicular to the axis of the prism.
 - d. Conduct tests no less frequently than that required to provide sets of prisms from each 5000 square feet of wall area installed but not less than three such tests for any building.
2. Report test results in writing and in form specified under each test method, to Architect and Contractor, on same day tests are made.
 3. Evaluation of Quality Control Tests: Masonry work, in absence of other indications of noncompliance with requirements, will be considered satisfactory if results from construction quality control tests comply with minimum requirements indicated.
 4. Retests: Where prism tests indicate non-compliance with specified requirements, additional testing shall be performed at the frequency of two additional tests for each unsatisfactory test. The cost of all such additional testing shall be the responsibility of the Contractor. Where retesting fails to indicate conformance with specified requirements, any masonry construction represented by unsatisfactory tests shall be removed and replaced with acceptable masonry construction.

PARGING

- A. Parge walls where indicated with Type S or N mortar, in thickness indicated.

Thickness: Not less than 1/2".

- B. Trowel finish to a smooth, dense surface. Form a wash at top of parging and a cove at bottom. Where parging is applied in 2 coats, roughen first coat when partially set, let harden for 24 hours and moisten prior to application of second coat.
- C. Damp cure parging for at least 24 hours and protect until cured.

REPAIR, POINTING, CLEANING & SEALING

- A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.
- B. Pointing:
 1. During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point up all joints including corners, openings and adjacent work to provide a neat, uniform appearance, prepared for application of sealants. If the repairs must be made after the mortar has hardened, the joint must be raked or chiseled out to a depth of about 1/2" thoroughly wetted, and repointed with fresh mortar.
 2. To pre-hydrate mortars, thoroughly mix all ingredients except water in proportions used for original mortar mix; then mix again, adding only enough water to produce a damp unworkable mix which will retain its form when pressed into a ball. After 1 to 2 hours, add sufficient water to bring it to the proper consistence; that is conventional masonry mortars.

C. Final Cleaning:

1. After mortar is thoroughly set and cured, clean masonry as follows:
 - a. Remove large mortar particles by hand with wooden paddles and non-metallic scrape hoes or chisels.
 - b. Test cleaning methods on sample wall panel; leave 1/2 panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - c. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film or waterproof masking tape.
 - d. Saturate wall surfaces with water prior to application of cleaners; remove cleaners promptly by rinsing thoroughly with clean water.
 - e. Use bucket and brush hand cleaning method described in BIA "Technical Note No. 20 Revised" to clean brick masonry made from clay or shale, except use masonry detergent cleaner.
 - f. Remove efflorescence in accordance with brick manufacturer's recommendations and as approved by Architect.
 - g. Clean concrete unit masonry to comply with masonry manufacturer's directions and applicable NCMA "Tek" bulletins.

D. Sealing Brick:

1. After masonry wall is thoroughly cleaned and dry seal as follows:
 - a. Refer to section 071916 - WATER REPELLENT for masonry sealer.
 - b. Avoid overspray on to adjacent building components and wall surfaces.

E. Protection and Cleanup:

1. Provide final protection and maintain conditions in a manner acceptable to Installer, which ensure unit masonry work being without damage and deterioration at time of substantial completion.
2. Leave work area and surrounding surfaces clean and free of mortar spots, droppings, and broken masonry.

END OF SECTION 04 20 00

SECTION 04 85 20 – NATURAL VENEER STONE

SECTION INCLUDES

- A. Section includes cut veneer masonry construction of natural stone set in cement mortar over a structural cavity wall backing of:
1. Gypsum sheathing.

RELATED SECTIONS

- A. Section 03 30 00 - Cast-In-Place Concrete: Concrete Foundations.
B. Section 05 50 00 - Metal Fabrications: Shelf angles, structural supports, anchors and other built-in components for building into stone veneer masonry by this section.
C. Section 05 40 00 - Cold-Formed Metal Framing: Formed steel framed supporting wall.
D. Section 07 62 00 - Sheet Metal Flashing and Trim.
E. Section 07 65 00 – Flexible Flashing
F. Section 07 90 00 - Joint Sealants: Sealant for perimeter and control joints.

REFERENCES

- A. ASTM C 91 - Standard Specification for Masonry Cement.
B. ASTM C 97 - Standard Specification for Absorption and Bulk Specific Gravity of Dimension Stone.
C. ASTM C 144 - Aggregate for Masonry Mortar.
D. ASTM C 150 - Standard Specification for Portland Cement.
E. ASTM C 170 - Standard Specification for Compressive Strength of Dimension Stone.
F. ASTM C 207 - Standard Specification for Hydrated Lime for Masonry Purposes.
G. ASTM C 270 - Mortar for Unit Masonry.
H. ASTM C 568 - Standard Specification for Limestone Dimension Stone.
I. ASTM C 616 - Standard Specification for Quartz Based Dimension Stone.
J. ASTM C 780 - Preconstruction Evaluation of Mortar for Plain & Reinforced Masonry.
K. ASTM C 880 - Standard Specification for Flexural Strength of Dimension Stone.

SUBMITTALS

- A. Product Data:
1. Submit manufacturer's product data for each type of masonry unit, accessory, and other manufactured products, including certifications that each type complies with specified requirements. Provide certification of pull-out strength of all masonry ties and anchors. Submit certification of compliance with required standards for all masonry units. Submit one sample each of all masonry accessories items.
- B. Quarrier or natural stone data sheets on stone and mortar mix to be used, including:
1. Preparation instructions and recommendations.
 2. Storage and handling requirements and recommendations.
 3. Installation methods.
 4. Cleaning methods.
- C. Design Data: Submit design mix when Property specification of ASTM C270 is to be used, with required environmental conditions, and admixture limitations.

- D. Selection Samples: For each stone product specified, submit two samples, minimum size 6 inches square, representing actual product, color, and texture.
- E. Samples: Submit samples of mortar representing actual mortar color and color range.
- F. For full size mock-up Reference Mock-up requirements in section 01 45 00 Quality Control.
- G. Include all stone unit types and sizes to be used including a typical corner condition, special shapes and mortar joint treatment. Clean the sample panel using the same materials and tools as planned for the final stone masonry construction.
- H. Do not proceed with remaining work until workmanship and color is approved by Architect.
- I. Do not remove sample panel until construction activities of this section have been accepted by the Architect.

QUALIFICATIONS

- A. Stone Source: Stone Company specializes in quarrying and processing products specified in this section with minimum five years documented experience.
- B. Stone Masonry Company: Company specializing in performing Work of this section with minimum five years documented experience.

QUALITY ASSURANCE

- A. Preconstruction Meetings: Conduct preconstruction meetings including the Architect, Contractor, stone masonry subcontractor, and the flashing subcontractor to verify project requirements, substrate conditions, manufacturer's installation instructions and other requirements. Comply with Division 1 requirements.
- B. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship. Finish areas designated by Architect
- C. Do not proceed with remaining work until workmanship, color, and texture are approved by Architect.
- D. Refinish mock-up areas as required to produce acceptable work.

DELIVERY, STORAGE, AND HANDLING

- A. Store products on pallets, under cover and in manufacturer's unopened packaging until ready for installation.
- B. Store stone materials on pallets on a dry level surface. Pallets shall not be stacked and shall be covered with tarps.
- C. Store mortar under cover and in an area where temperature is maintained between 40 degrees F to 110 degrees F.

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. Hot and Cold Weather Requirements: In accordance with ACI 530.1/ASCE 6/TMS 602 Specifications for Masonry Structures.
- C. Ambient temperature shall be 40 degrees F or above during erection of stone masonry. When ambient temperature falls below 50 degrees F, mortar mixing water shall be heated.

PRODUCTS

MANUFACTURERS

- A. (Basis of Design) Acceptable Manufacturer: AJ Brauer Stone, 4060 County Rd 305, Jarrell, Texas, 76537. (512)-746-5792. sales@ajbrauer.com
Website: www.ajbrauer.com

Contact:

Les Hoelscher - Martini Brick Sales Inc.
3749 Apollo Road, Corpus Christi, Texas 78413
les@martinibricksales.com
Cell: 361-438-6738
Ph: 361-854-7573
Fax: 361-854-0254

- B. Requests for substitutions must be coordinated through contact listed above and will be considered in accordance with provisions of Section 01 25 00.

VENEER STONE

- A. White Limestone: Provided in the following sizes and colors:
 - 1. Style: Random Ashlar - Sawn Top and Bottom, Chopped Front and Back
 - a. Pattern:
 - 1) Heights: 4" -6" -8.5". Equal amounts of each size.
 - 2) Lengths: 12" -18".
 - 3) Nominal Thickness: 3.25" -4".
 - 4) Color/Blend: White Limestone

SPECIAL SHAPES

- A. Provide special cast stone shapes as indicated on the Drawings and as follows:
 - 1. Sills.
 - 2. Window Surrounds
- B. Cast Stone:
 - 1. Finish: Honed.

2. Sizes: Profile, Length and Width as indicated on drawings.
3. Comply with ASTM C568

C. Color shall be:

1. As indicated on drawings.

ACCESSORIES

MORTAR

A. Masonry Cement: Complying with ASTM C91:

1. Type S.
2. Color, gray is recommend

B. Portland Cement: Complying with ASTM C150:

1. Type I.
2. Color, gray is recommended

C. Mortar Aggregate: Complying with ASTM C144, standard masonry type.

D. Hydrated Lime: Complying with ASTM C207:

1. Type S.

E. Water: Clean and potable. Mixing water must be free of harmful amounts of acids, alkalis, organic materials, or other substances that would adversely affect the quality or appearance of the mortar or stone.

MIXES

A. Mortar Mixes:

1. Mortar for Structural Masonry: Complying with ASTM C270, using Proportion Specification.
2. Type S.

B. Mortar Mixing:

1. Mix mortar ingredients in accordance with ASTM C270. Mix only in quantities needed for immediate use. Do not use anti-freeze compounds to lower freezing point of mortar.

JOINT REINFORCEMENT, TIES & ANCHORING DEVICES

A. General:

1. Comply with requirements indicated below for basic materials and with requirements indicated under each form of joint reinforcement, tie and anchor for size and other characteristics:
2. Manufacturers:
 - a. Subject to compliance with requirements, provide products of one of the following:
 - (i) AA Wire Products Co.
 - (ii) Dur-O-Wall, Inc.
 - (iii) Hohmann & Barnard, Inc.
 - (iv) National Wire Products Corp.

- b. Other manufacturers shall be used only with Engineer approval. The Contractor shall submit technical literature for all reinforcing units.
- B. Hot-Dip Galvanized Steel Wire:
1. ASTM A 82 for uncoated wire and ASTM A 153, Class B-2 (1.5 oz. per sq. ft. of wire surface) for zinc coating applied after prefabrication into units.
 - a. Application: Use for masonry exposed to exterior and in contact with earth.
- C. Zinc-Coated (Galvanized) Steel Sheet:
1. Carbon steel with zinc coating complying with ASTM A 525, Coating Designation G90.
 - a. Application: Use for dovetail slots and where indicated.
- D. Hot-Dip Galvanized Carbon Steel Sheet:
1. ASTM A 366, Class 2 or ASTM A 635; hot-dip galvanized after fabrication to comply with ASTM A 153, Class B.
 - a. Application: Use for anchors.
- E. Joint Reinforcement:
1. Provide welded-wire units prefabricated with deformed continuous side rods and plain cross rods in straight lengths of not less than 10 feet, with prefabricated corner and tee units, and complying with requirements indicated below:
 - a. Width: Fabricate joint reinforcement in units with widths a minimum of 2" less than nominal width of walls. Provide mortar coverage over joint reinforcement of not less than 5/8" on joint faces exposed to exterior and 1/2" elsewhere.
 2. Wire Size for Side and Cross Rods:
 - a. 0.1483" diameter (9 ga.) for all masonry construction except as noted below.
 3. For single-wythe masonry provide type as follows with single pair of side rods:
 - a. Ladder design with perpendicular cross rods spaced not more than 16" o.c.
- F. Bent-Wire Ties:
1. Provide individual prefabricated bent-wire units complying with requirements indicated below:
 - a. Wire Size: 0.1875" diameter.
 - b. Length: Provide units of length indicated but not less than that required for embedment into each wythe of 2" for solid units and for a minimum of 2" embedment of tie end into face shells of hollow units, with not less than 5/8" mortar cover on exterior face joints, 1/2" elsewhere.
 - c. Tie Shape for Solid Masonry Unit Construction: Z-shaped ties with ends bent 90° to provide hooks not less than 2" long.
 - d. Type for Masonry where Coursing Between Wythes Align: Unit ties bent from one piece of wire.
 - ef. Type for Masonry where Coursing Between Wythes Does Not Align:
 - (i) Adjustable ties composed of two parts, one with a pintle, the other with an eye.
- G. Flexible Anchors:

1. Where flexible anchors are indicated for connecting masonry to structural framework, provide 2-piece anchors as described below which permit vertical or horizontal differential movement between wall and framework parallel to, but resist tension and compression forces perpendicular to, plane of wall:
 - a. For anchorage to concrete framework, provide manufacturer's standard anchors with dovetail anchor section formed from 0.1046" (12 gage) thick sheet metal and triangular-shaped wire tie section sized to extend within 1" of masonry face.
 - b. For anchorage to steel framework provide manufacturer's standard anchors with crimped 1/4" diameter wire anchor section for welding to steel and triangular-shaped wire tie section sized to extend within 1" of masonry face.
 - c. Wire Size: 0.1875" diameter.

H. Masonry Veneer Anchors:

1. Provide individual prefabricated bent-wire units complying with requirements indicated below:
 - a. Wire Size: 0.1875" diameter.
 - b. Length: Provide units of length indicated but not less than that required for embedment into each wythe of 2" for solid units and for a minimum of 2" embedment of tie end into face shells of hollow units, with not less than 5/8" mortar cover on exterior face joints, 1/2" elsewhere.

I. Rigid Anchors:

1. Provide straps of form and length indicated, fabricated from sheet metal strips of following width and thickness, unless otherwise indicated. Typical length to be 24" plus 2" long, 90° bends at ends.
 - a. Width: 1-1/4"
 - b. Thickness: 1/4"

J. Unit Type Masonry Inserts in Concrete:

1. Furnish cast iron or malleable iron inserts of type and size indicated.

K. Dovetail Slots:

1. Furnish dovetail slots, with filler strips, of slot size indicated, fabricated from 0.0336" (22 gage) sheet metal.

L. Anchor Bolts:

1. Provide steel bolts with hex nuts and flat washers complying with ASTM A 307, Grade A, hot-dip galvanized to comply with ASTM C 153, Class C, in sizes and configurations indicated.

CONCEALED FLASHING MATERIALS

A. Sheet Metal Flashing:

1. Fabricate from the following metal complying with requirements specified in Section 07 55 20 - Modified Bitumen Membrane Roofing and below:

a. Stainless Steel: 0.015" thick.

2. Fabricate through-wall metal flashings with deformation in both directions for integral mechanical mortar bond.

B. Membrane Flashing:

1. Refer to Section 07 10 00 – Waterproofing & Dampproofing.

MISCELLANEOUS MASONRY ACCESSORIES

A. Weepholes:

Louvered or Honeycomb polypropylene design to allow passage of moisture from cavity to the building. Size vents to fit head joints of brick or block being used.

1. Basis of Design: QV - Quadro-Vent by Hohmann and Barnard, Inc.

2. Color: Grey where uncolored mortar is used. As selected by Architect from manufacturer's full line of colors when colored mortar is used.

B. Cavity Drainage Material:

High density polyethylene strands woven into a 90% open mesh that breaks up mortar droppings and prohibits mortar from creating a moisture retaining barrier, allowing water to flow freely to the weep holes.

1. Basis of Design: Mortar Trap by Hohmann and Barnard, Inc.

C. Bond Breaker Strips:

Asphalt-saturated organic roofing felt complying with ASTM D 226, Type I (No.15 asphalt felt).

EXECUTION

EXAMINATION

A. Do not begin installation until backing structure is plumb, bearing surfaces are level and substrates are clean and properly prepared.

B. Verify that built-in items are in proper location, and ready for roughing into stone masonry.

C. Notify Architect of unsatisfactory preparation before proceeding.

PREPARATION FOR INSTALLATION OF VENEER STONE

A. Coordinate placement of reinforcement, anchors and accessories, flashings and weep holes and other moisture control products supplied by other sections.

B. Clean all built-in items of loose rust, ice, mud, or other foreign matter before incorporating into the wall. All ferrous metal built into the wall shall be primed or galvanized.

- C. If required, provide temporary bracing during installation of masonry work. Maintain bracing in place until building structure provides permanent support.

INSTALLATION OF VENEER STONE

- A. Install veneer stone and mortar in accordance with ACI 530.1/ASCE 6/TMS 602 Specifications for Masonry Structures.
- B. Maintain masonry courses to uniform dimension(s). Form vertical and horizontal joints of uniform thickness.
- C. Pattern:
 - 1. Lay stone with the split-face, honed-face, or weather edge exposed, as described in stone veneer section 2.2. Take care to avoid a concentration of any one color to any one wall surface.
- D. Maintain an approximate 3/8 inch joint, as stone allows.
- E. Do not use stacked vertical joints.
- F. Lay out work in advance and distribute color range of stone uniformly over total work area.
- G. Placing and Bonding:
 - 1. Work from the bottom up laying corner pieces first.
 - 2. Remove excessive mortar as work progresses.
 - 3. Remove any units with orange, yellow or brown coloring.
- H. Joining Work: Where fresh masonry joins partially set masonry.
 - 1. Remove loose stone and mortar.
 - 2. Clean and lightly wet surface of set masonry.
 - E. To avoid a horizontal run of masonry, rack back 1/2 the length of stone in each course.
- I. Joints:
 - 1. Lay stone with an approximate 3/8 inch mortar joint, as stone allows.
 - 2. Tool joints when "thumb-print" hard with a round jointer slightly larger than the width of the joint.
 - 3. Trowel-point or concave tool exterior joints below grade.
 - 4. Flush cut joints to be finished with a soft brush only.
- J. Flashing:
 - 1. Clean surface of masonry smooth and remove any projections, which could damage flashings.
 - 2. Place flashing on a bed of mortar.
 - 3. Cover flashing with mortar.
- K. Control and Expansion Joints: Keep joints open and free of debris. Coordinate control joint in accordance with Section 07 90 00 for sealant performance.
- L. Sealant Recesses: Provide open joint 3/4 inch deep and 1/4 inch wide, where masonry meets doors, windows and other exterior openings. Coordinate sealant joints in accordance with Section 07 90 00 for sealant performance.

- M. Cutting And Fitting: Cut and fit for chases, pipes, conduit, sleeves, grounds, and other penetrations and adjacent materials. Coordinate with other sections of work to provide correct size, shape, and location.

LINTELS

- A. Install steel lintels where indicated.
- B. Provide masonry lintels where shown and wherever openings of more than 1'-0" for stone size units and 2'-0" for block size units are shown without structural steel or other supporting lintels. Provide precast or formed-in-place masonry lintels. Cure precast lintels before handling and installation. Temporarily support formed-in-place lintels until grout is properly cured.
- C. Provide minimum bearing of 8" at each jamb, unless otherwise indicated

FIELD QUALITY CONTROL

- A. Test mortar and grout in accordance with Section 014100.
- B. Testing of Mortar Mix: In accordance with ASTM C780, Annex A4, for mortar aggregate ratio and ASTM C 780, Annex A5, for mortar water content.

PROTECTION

- A. Protect installed products until completion of project. Cover the top of unfinished stone masonry work to protect it from the weather.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

CLEANING

- A. Keep the face of stone free of mortar as the work progresses. If residual mortar is on the face of the stone, allow to dry partially and brush the mortar off the surface and sponge off the residue.
- B. When the work is completed and the mortar has set for 2 to 3 days the surface may be cleaned from top to bottom using a mild masonry detergent acceptable to the stone manufacturer. Do not use metal brushes or acids for cleaning.

END OF SECTION 04 85 20

SECTION 05 12 00 - STRUCTURAL STEEL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. Extent of structural steel work is shown on drawings including schedules, notes and details which show size and location of members, typical connections, and type of steel required. Furnish all labor, materials, services, equipment and appliances required in conjunction with or related to the furnishing, fabrication, delivery, and erection of all structural steel defined below. Include all supplementary parts, members and connections necessary to complete the structural steel work, regardless of whether all such items are specifically shown or specified on the drawings.
- B. Structural steel shall be defined as that work prescribed in Section 2.1 of the AISC Code of Standard Practice and the following items: angle frames for openings in roofs, miscellaneous metal deck support and edge angles, shop welded metal studs, all connection material, temporary construction bracing, and all other structural steel shown or specified on the drawings to be part of the work. Labor shall include shop painting as specified, field touch-up painting, and grouting of base plates and bearing plates.
- C. Miscellaneous metal fabrications, architecturally exposed structural steel, metal stairs, steel joists, and metal deck are specified elsewhere in these Specifications.

1.3 QUALIFICATIONS

- 1. Fabricator: The structural steel fabricator shall have not less than 10 years experience in the successful fabrication of structural steel similar to this project. Evidence of compliance with this section shall be submitted to the Architect/Engineer.
- 2. Erector: The structural steel erector shall have not less than 5 years successful experience in the erection of structural steel of a similar nature to this project. Evidence of compliance with this section shall be submitted to the Architect/Engineer.

1.4 QUALITY ASSURANCE

The Contractor is responsible for quality control, including workmanship and materials furnished by his subcontractors and suppliers.

A. Codes and Standards:

Comply with provisions of the following, except as otherwise indicated:

1. All federal (OSHA), state and local laws which govern safety requirements for steel erection and other requirements if more stringent than the codes and standards enumerated below.
2. AISC "Code of Standard Practice for Steel Buildings and Bridges".
3. AISC "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings", including Commentary.
4. AISC "Specification for Structural Joints using ASTM A 325 or A 490 Bolts" approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation (Research Council on Structural Connections).
5. AWS D1.1 "Structural Welding Code - Steel".
6. "Steel Structures Painting Manual", Volumes 1 and 2, Steel Structures Painting Council.

B. Qualifications for Welding Work:

Qualify welding processes and welding operators in accordance with AWS "Structural Welding Code - Steel".

1. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests.
2. If recertification of welders is required, retesting will be Contractor's responsibility.

C. Source Quality Control: Materials and fabrication procedures are subject to inspection and tests in the mill, shop, and field by the Owner's testing laboratory. Such inspections and tests will not relieve the Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements. The Contractor shall promptly remove and replace materials or fabricated components which do not comply.

D. Question about Contract Documents: The Contractor shall promptly notify the Architect/Engineer whenever design of members and connections for any portion of the structure are not clearly indicated or when other questions exist about the

Contract Documents. Such questions shall be resolved prior to the submission of shop drawings.

- E. Testing Laboratory Services: See Structural Drawings required testing. Inspection or testing by the Owner does not relieve the Contractor of his responsibility to perform the Work in accordance with the Contract Documents.

1.5 SUBMITTALS

A. Shop Drawings:

1. General Requirements: Submit shop drawings including complete details and schedules for fabrication and assembly of structural steel members, and details, schedules, procedures and diagrams showing sequence of erection. Shop drawings not complying with the above requirements will not be reviewed. Structural steel shop drawings shall include the following minimum information:
 - a. Include details of cuts, connections, camber, holes, and other pertinent data. Indicate welds by standard AWS symbols, and show size, length, and type of each weld. Holes, flange cuts, slots and openings shall be made as required by the structural drawings, all of which shall be properly located by means of templates.
2. The fabricator alone shall be responsible for all errors of detailing, fabrication, and for the correct fitting of the structural members.
3. All fabricated material and connections shall fit within architectural constraints.
4. Structural steel members for which shop drawings have not been reviewed and approved shall not be fabricated.
5. The omission from the 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 the shop drawings may have been reviewed and approved.

- B. Test Reports: Submit copies of reports of tests conducted on all field-welded connections that are inspected. Include data on type(s) of tests conducted and test results.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to site at such intervals to ensure uninterrupted progress of work.
- B. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete or masonry, in ample time so as not to delay work.

- C. Store materials to permit easy access for inspection and identification. Keep steel members off ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration. Do not store materials on structure in a manner that might exceed allowable loads on or cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed by Architect/Engineer.
- D. Furnish all fuel, maintenance, and equipment required for hoisting and placement of materials under this contract.
- E. Process, pay for and maintain all permits and certificates of on-site inspection required for derricks, cranes and hoisting equipment. No derrick, crane or hoisting equipment shall be operated without a certificate of operation and a certificate of on-site inspection, as required by governing authorities.
 - 1. Wherever the erection equipment is supported by the structure, the Contractor shall be responsible for the retention of a licensed professional engineer to determine the adequacy of the member supporting the erection equipment in relation to the loads imposed thereon. The Contractor shall submit to the Architect/Engineer, for review, the loads which will be imposed by the erection equipment on the building structure. Where the imposed load exceeds the allowable stresses, the Contractor shall be responsible for any additional materials, supports, bracing, connections and similar measures required to support the imposed load of the equipment while in use, subject to review by the Architect/Engineer.
 - 2. In addition to the above, all hoisting equipment shall be installed, operated and maintained in accordance with all applicable regulations of authorities having jurisdiction.
 - 3. Street storage and sidewalk crossing permits shall be furnished by the Contractor.

1.7 JOB CONDITIONS

The Contractor shall coordinate the fabrication and erection of all structural steel work with the work of other trades. The contractor shall verify existing conditions prior to beginning work. The contractor shall verify all dimensions shown on the drawings with existing job conditions prior to beginning work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Structural Steel: All hot rolled steel plates, shapes, sheet piling, and bars shall be new steel conforming to ASTM Specification A6 "Standard Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use". Structural steel shall comply with the provisions of the

following ASTM Specifications as appropriate for the grades and types, and at the locations as specified on the drawings:

1. Structural Steel Shapes, Plates and Bars - Carbon Steel, ASTM A992 GR50 "Standard Specification for Structural Steel."
 2. Pipe Columns - ASTM A53 (Type E or S) Grade B, or ASTM A501.
 3. Tube Sections - ASTM A500 Grade B. FY = 46 KSI
 4. Connection Material: All connection material except as noted otherwise on the drawings including bearing plates, gusset plates, stiffener plates, filler plates, angles, etc. shall be A36 steel unless a higher or matching grade of steel with the members connected is required by strength or stiffness calculations and provided the resulting sizes are compatible with the members connected.
- B. Structural Bolts and Threaded Fasteners: Structural bolts and threaded fasteners shall comply with the following ASTM Specifications as appropriate for the types and at the locations as specified on the drawings:
1. ASTM A307 Grade A, "Carbon Steel Externally Threaded Standard Fasteners".
 2. ASTM A325 Type 1, "High-Strength Bolts for Structural Steel Joints".
 3. Bolts and Nuts, High Strength Bolts: Bolts and nuts for all high strength bolts shall be heavy hex head conforming to ANSI Standards B18.2.1 and B18.2.2 respectively. Nuts shall conform to ASTM A563, "Standard Specification for Carbon and Alloy Steel Nuts".
 4. Washers: All washers shall be circular, flat and smooth and shall conform to the requirements of Type A washers in ANSI Standard B23.1. Washers for high strength bolts shall be hardened and conform to ASTM F436, Specification for Hardened Steel Washers. Beveled washers for American Standard Beams and channels shall be square or rectangular, shall taper in thickness (16 2/3% slope) with an average thickness of 5/16". When an outer face of a bolted part has a slope greater than 1:20 with respect to a plane normal to the bolt axis, a beveled washer shall be used.
 5. Bolt Lubrication: All bolts shall be well lubricated at time of installation. Dry, rusty bolts will not be allowed. Bolts or nuts shall be wax dipped by the bolt supplier or "Johnson's Stick Wax 140" shall be used with all bolts in the shop or field.
 6. New Bolts: All bolts shall be new and shall not be reused.
- C. Electrodes for Welding: Comply with AWS D1.1, "Structural Welding Code - Steel". Electrodes for various welding processes shall be as specified below:
1. SMAW: E70XX low hydrogen
 2. SAW: F7X-EXXX

3. GMAW: ER70S-X
4. FCAW: E7XT-X
5. Weathering Steel Electrodes shall conform to Table 4.1.4 of the AWS D1.1 Manual.

Electrodes shall be compatible with parent metal joined.

- D. Structural Steel Primer Paint: Primer paint shall be one of the following types with the indicated surface preparation:

1. SSPC-Paint 1, 100% red lead and linseed oil, TT-P-86 Type I, surface prepared according to SSPC-SP-2 (Hand Tool Cleaning). All materials shall be lead and chromate free.
2. SSPC-Paint 2, red lead-iron oxide and oil-alkyd, surface prepared according to SSPC-SP-2 (Hand Tool Cleaning). All materials shall be lead and chromate free.
3. TT-P-86, Type II, red lead-iron oxide and oil-alkyd, surface prepared according to SSPC-SP-3 (Power Tool Cleaning). All materials shall be lead and chromate free.
4. TT-P-86, Type III, 100% red lead and alkyd varnish, surface prepared according to SSPC-SP-6 (Commercial Blast Cleaning) or SSPC-SP-8 (Pickling).
5. Alkyd Zinc Chromate Metal Primer 0239 Gray as manufactured by Devco Napco (SSPL-SP6 Commercial Blast Cleaning).
6. Alkyd Fast Dry Primer 298 as manufactured by Porter Paints (SSPL-SP6 Commercial Blast Cleaning).
7. Modified Alkyd Rust Inhibitive Primer 4-56 as manufactured by Tnemec Company, Inc. (SSPL-SP6 Commercial Blast Cleaning).

Refer to Architect's drawings and specifications for final paint finish requirements of structural steel. Primer paint shall be compatible with final paint requirements.

2.2 FABRICATION

- A. Shop Fabrication and Assembly:

1. Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC Specification and as indicated on approved final shop drawings. Fabricator shall coordinate joint fit-up procedures with erector. Provide camber in structural members where indicated. The General Contractor shall coordinate provision of all erection bolts, lifting lugs or other devices required for erection with the fabricator and the erector.

2. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
 3. Clearly mark the grade of steel on each piece, distinguishable in the field from floor surfaces, for purpose of field inspection and confirmation of grade of steel.
- B. Dimensional Tolerances: Dimensional tolerances of fabricated structural steel shall conform to Section 6.4 of the AISC Code of Standard Practice.
- C. Splices in Structural Steel: Splicing of structural steel members in the shop or the field is prohibited without prior approval of the Engineer. Any member having a splice not shown and detailed on approved shop drawings will be rejected.
- D. Cutting: Manual oxygen cutting shall be done only with a mechanically guided torch. An unguided torch may be used provided the cut is not within 1/8 inch of the finished dimension and final removal is completed by means such as chipping or grinding to produce a smooth surface quality free of notches or jagged edges. All corners shall be smooth and rounded to a minimum 1/2" radius.

2.3 WELDING

- A. Code: All shop and field welding shall conform to all requirements in the "Structural Welding Code - Steel", ANSI/AWS D1.1, as published by the American Welding Society (AWS).
- B. Welder Certification: All shop and field welders shall be certified according to AWS procedures for the welding process and welding position used. Submit certification certificates to the Architect for record purposes.
- C. Minimum Size and Strength:
1. Fillet Welds: Minimum size of fillet welds shall be as specified in Table 1.17.2A in the AISC Manual of Steel Construction.
 2. Minimum Strength of Welded Connections: Unless noted otherwise on the drawings, all shop and field welds shall develop the full tensile strength of the member or element joined. All members with moment connections, noted on the drawings with "MC", shall be welded to develop the full flexural capacity of the member, unless noted otherwise on the drawings.
- D. Filler Metal Requirements: Weld metal shall be as specified in AISC Manual of Steel Construction Table 1.5.3.
- E. Welding Procedures:

1. Welds not specified shall, if possible, be continuous fillet welds developing the minimum strength, as specified above, using not less than the minimum fillet welds as specified by AISC.

2.4 SURFACE PREPARATION AND PAINTING

- A. Specification: Surface preparation, paint, and painting practices shall conform to the "Steel Structures Painting Manual", Volumes 1 and 2, as published by the Steel Structures Painting Council (SSPC).
- B. Scope: Shop paint all steel.
- C. Surface Preparation and Primer Paint - Shop Painted Steel: All structural steel specified to be shop primed shall have paint applied in strict accordance with manufacturers instructions using prescribed surface preparation but not less than specified. Paint shall be applied immediately after surface preparation at a rate to provide a uniform dry film thickness of not less than 1.5 mils. Painting methods shall be used which result in full coverage of joints, corners, edges, and all exposed surfaces. Two coats shall be applied to surfaces which are inaccessible after assembly or erection. The color of the second coat shall be changed to distinguish it from the first coat.

Coordinate shop primer paint requirements with Architectural drawings and specifications.

PART 3 - ERECTION

3.1 ERECTION

- A. Inspection: Erector shall examine areas and conditions under which structural steel work is to be installed and notify the Contractor and the Architect/Engineer in writing of conditions detrimental to proper and timely completion of the work.
- B. Erection Tolerances: Erection tolerances of anchor bolts, embedded items, and all structural steel shall conform to the AISC Code of Standard Practice.
- C. Field Assembly of Structural Steel:
 1. As erection of the steel progresses, the work shall be fastened securely to take care of all dead load, wind and erection stresses. Particular care shall be exercised to ensure straightness and tautness of bracing immediately upon raising a steel column.
 2. Provide temporary planking and working platforms as necessary to effectively complete work.
 3. Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming part of complete frame or structure

- before permanently fastening. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment. Level and plumb individual members of structure within specified AISC tolerances. The Contractor shall coordinate with Erector and Fabricator regarding possible discrepancies in member lengths between temperature at time of fabrication and temperatures during erection, and shall make necessary adjustments to ensure plumbness within AISC tolerances at 60°F. Compensate for cumulative welding draw, construction loadings, sequential applications of dead loads, or any other predictable conditions that could cause distortions to exceed tolerance limitations.
4. On exposed welded construction, remove erection bolts, fill holes with plug welds or filler and grind smooth at exposed surfaces.
 5. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces receiving field welds.
 6. Comply with all bolting and welding requirements of Part 2 of this specification section.
 7. Remove and replace existing finish materials as required to accomplish all work. The contractor shall comply with all fire codes when performing welding of steel or metal studs.
- D. Field Modifications to Structural Steel: Errors in shop fabrication or deformation resulting from handling and transportation that prevent the proper assembly and structural fitting of parts shall be reported immediately to the Architect/Engineer, and approval of the method of correction shall be obtained. Approved corrections shall be made at no additional cost to the Owner. Do not use cutting torches, reamers, or other devices in the field for unauthorized correction of fabrication errors.
- E. Miscellaneous Framing: Provide supplemental structural steel support framing for metal deck where normal deck bearing is interrupted by column flange plates or other framing members and other floor openings whether shown or not on either the architectural, mechanical, or structural drawings.
- F. Removal of Erection Aids and Devices: The erector shall remove all erection aids and devices that interfere with architectural finish or MEP requirements.
- G. Touch-Up Painting:
1. Immediately after erection, clean field welds, bolted connections, and abraded areas that have been shop painted. Apply paint to exposed areas using same material and surface preparation as used for shop painting. Apply by brush or spray to provide minimum dry film thickness of 1.5 mils.

2. All field welded galvanized connections shall have welds protected with "Z.R.C. Cold Galvanizing Compound" as manufactured by Z.R.C. Products Company.
- H. Clean Up: Clean up all debris caused by the Work of this Section, keeping the premises neat and clean at all times. Replace and repair to like new condition, all damaged areas of the interior and exterior of the building.

END OF SECTION 05 12 00

SECTION 052000 - STEEL JOISTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 SCOPE OF WORK

A. Extent of steel joists is shown on drawings, including basic layout and type of joists required.

B. Quantity of joists required shall be determined from the contract drawings.

1.3 QUALITY ASSURANCE

The Contractor is responsible for quality control, including workmanship and materials furnished by his subcontractors and suppliers.

A. Design and Fabrication: Provide joists designed and fabricated in compliance with the following, and as herein specified.

1. Steel Joist Institute (SJI) Standard Specifications, Load Tables and Weight Tables for K, LH, and DLH Series Steel Joists.
2. Recommended Code of Standard Practice for Steel Joists and Joist Girders.
3. Local fabrication requirements of governing authorities such as the city, county and state having jurisdiction over the site where the project is located.
4. American Welding Society AWS D1.1 Structural Welding Code - Steel or SJI Technical Digest #8 "Welding of Open Web Steel Joists" with successful passage of load tests as defined in this specification section.

1.4 SUBMITTALS

A. Shop Drawings: Submit detailed drawings showing layout of joist units, connections, jointing and accessories. Include length, camber, mark, number, type, location and spacing of joists and bridging. Submit details for member splices.

1.5 DELIVERY, STORAGE AND HANDLING

Deliver, store and handle steel joists as recommended in SJI specifications. Handle and store these in a manner to avoid deforming members and to avoid excessive stresses.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Steel: Comply with SJI specifications.
- B. Unfinished Threaded Fasteners: ASTM A307, Grade A, regular hexagon type, low carbon steel.
- C. High-Strength Threaded Fasteners: ASTM A 325 or A 490 heavy hexagon structural bolts with nuts and hardened washers.
- D. Steel Prime Paint: Comply with SJI specifications.

2.2 FABRICATION

- A. General: Fabricate steel joists in accordance with all documents listed in "Quality Assurance", except as noted below.
- B. Splices in Chord Members: All splices shall be designed and provided in accordance with SJI Specifications. The splices in each of the two angles or bars of all members shall not be at the same location, but shall be staggered a minimum of 6 inches.
- C. Holes in Chord Members: Provide holes in chord members where shown in contract drawings for securing other work to steel joists; however, deduct area of holes from the area of chord when calculating strength of member.
- D. Joists shall be cambered for dead loads: Provide all joists with SJI standard camber unless specified otherwise on the drawings. Review the Structural Drawings and Specifications for information concerning dead loads for joists requiring other than standard camber. Joist camber must be shown on shop drawings submitted for review. Camber not shown on shop drawings shall be cause for rejection of shop drawings.
- E. Joist Bearing: Provide minimum end bearing of joists as required by SJI specifications but subject to requirements below:

Joists Less than 60-Foot Span:

- a. If two joists do not abut each other at a support, provide required joist bearing centered on the supporting member unless detailed otherwise on the drawings.
- b. If two joists abut each other at a support and sufficient minimum bearing for each joist exists, provide 1/4" space between joist ends centered over the support unless details otherwise on the drawings.

- c. If two joists abut each other at a support and sufficient minimum bearing for each joist does not exist at the support, offset the ends of each joist and center joist bearing on the center of the support.
- F. Top Chord Extensions and Extended Ends: Provide top chord extensions and extended ends on joists where shown in contract drawings complying with the requirements of SJI specification and load tables. Top chord extensions shall extend back to the first interior panel point from the joist exterior panel point as a minimum.
- G. Ceiling Extensions: Provide ceiling extensions in areas having ceilings attached directly to joist bottom chord. Provide either an extended bottom chord element or a separate unit, to suit manufacturer's standards, of sufficient strength to support ceiling construction. Extend ends to within 1/2" of finished wall surface unless otherwise indicated.
- H. Bridging: Provide horizontal and/or diagonal type bridging for all joists, complying with SJI specifications.
 - 1. Examine the drawings carefully for special bridging requirements.
 - 2. Provide bridging anchors for ends of bridging lines terminating at walls or beams.
- I. End Anchorage: Provide end anchorages to secure joists to adjacent construction, complying with SJI specifications, unless otherwise indicated.
- J. Header Units: Any situation requiring heading of joists not shown on the structural drawings shall be referred to the manufacturer's engineer for framing.
- K. Shop Painting: Remove loose scale, heavy rust, grease, oil and other foreign materials from fabricated joists and accessories by rotary wire brushes and/or solvents before application of shop paint.

Apply one shop coat of primer paint to steel joists and accessories, by spray, dipping, or other method to provide a continuous dry paint film thickness of not less than 0.50 mil.

PART 3 - EXECUTION

3.1 ERECTION

- A. Place and secure steel joists strictly in accordance with SJI code of standard practice, SJI specifications, final shop drawings, and as herein specified.
- B. Placing Joists: Do not start placement of steel joists until supporting work is in place and secured. Place joists on supporting work, adjust and align in accurate locations and spacing before permanently fastening.

1. Provide required bridging, connections, and anchors to ensure lateral stability during construction. Remove as required for architectural, structural, and mechanical clearances after erection.
 2. Where members support joists from both sides, and the supporting width does not meet the SJI recommendations for bearing lengths of both joists, then offset joists to provide recommended bearing lengths. Such offsets shall be subject to approval by the Architect/Engineer.
- C. Bridging: Install bridging simultaneously with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords where terminating at walls or beams.

3.2 FASTENING JOISTS

- A. Do not permit erection of decking until joists are secured to supporting members, and are properly braced.
- B. Field weld joists to supporting steel framework in accordance with SJI specifications for type of joists used. Coordinate welding sequence and procedure with placing of joists.
- C. Joists where shown with bottom chord extensions shall not have the bottom chords connected to the supporting members until the full dead load is applied.
- D. Secure joists resting on masonry or concrete bearing surfaces by bedding in grout and anchoring to masonry or concrete construction as specified in SJI specifications for type of steel joist used.
- E. Touch-Up Painting: After joist installation, paint field bolt heads and nuts, welded areas, and abraded or rusty surfaces on joists and steel supporting members. Wire brush surfaces and clean with solvent before painting. Use same type of paint as used for shop painting.

3.3 ATTACHMENTS TO JOISTS

- A. The Contractor shall ensure that no cuts or holes are made in the members of the erected joists for attachment of ceiling, ducts, pipes, or any other items not specifically shown in the contract drawings. Use of power driven fasteners in the diagonal and bottom chord members of the joists is prohibited.
- B. The Contractor shall not hang any elements from the top or bottom chords of joists except ceiling, ducts, pipes or other items specifically shown on the Contract Documents, without the written authorization of the Engineer.

All pipes, ducts, and other mechanical, electrical, and plumbing equipment suspended from the joists shall have the hanger attached at a joist panel point only. No mechanical, electrical, or plumbing equipment shall be hung along the top or bottom chord between panel points except as approved otherwise in writing by the Architect/Engineer.

All ceilings weighing 3 PSF or less may have the grid hung anywhere along the bottom chord. Ceilings weighing more than 3 PSF shall have the grid hung only at joist panel points.

Heavy pipes, ducts, or other equipment hung from bar joists may require additional joist reinforcement and shall be referred to the Engineer for framing.

3.4 FIELD INSPECTION

Joists welded in place are also subject to inspection and testing. Remove and replace work found to be defective and provide new acceptable work at no cost to Owner. Expense of removing and replacing any portion of the steel joists for testing purposes will be borne by the Owner if welds are found to be satisfactory.

END OF SECTION 05 20 00

SECTION 053100 - STEEL ROOF DECK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 1 - Specification sections, apply to work of this section.

1.2 SCOPE OF WORK

- A. Supplier: The metal deck supplier shall furnish all metal deck materials and accessories indicated on the Architectural, Structural, and Mechanical Drawings required to produce a complete job including but not necessarily limited to deck units, cover plates, pour stops, metal deck edge closures, cell closures, cant strips, sump pans, and all related accessories.
- B. Erector: The Subcontractor responsible for erecting the metal deck shall provide all labor and equipment as required to place all metal deck components and accessories as described above.

1.3 QUALIFICATIONS

The metal deck supplier shall be a manufacturer with a minimum of two years successful experience and with a minimum of two successful jobs of a comparable size and scope to this project.

1.4 QUALITY ASSURANCE

The Contractor is responsible for quality control, including workmanship and materials furnished by his subcontractors and suppliers.

- A. Codes and Standards: Comply with provisions of the following codes and standards except as otherwise indicated or specified:
 - 1. "Design Manual for Composite Decks, Form Decks, and Roof Decks", as published by the Steel Deck Institute (SDI).
 - 2. "Specification for the Design of Cold Formed Steel Structural Members", as published by the American Iron and Steel Institute (AISI).
 - 3. "Structural Welding Code - Steel", as published by the American Welding Society (AWS).
- B. Qualification of Field Welding: Qualify welding processes and welding operators in accordance with AWS procedures.

1.5 SUBMITTALS

- A. Product Certification: Submit manufacturer's specifications and installation instructions for each type of deck specified. Also submit a certificate of product compliance with SDI Standards as specified.
- B. Shop Drawings: Submit detailed shop drawings showing type of deck, complete layout, attachment details, closures, edge strips, supplementary framing, and all other accessories.
- C. Insurance Certification: Assist Architect and Owner in preparation and submittal of roof installation acceptance certification as may be necessary in connection with fire, windstorm, and extended coverage insurance.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. See General Notes on the drawings for the location, depth, design thickness, section properties, and suggested manufacturer for all required roof decks.

2.2 GRADES OF STEEL

Steel deck shall be manufactured from steel conforming to ASTM Designation A611 Grades C, D, or E for painted deck or A446 Grades A, B, C, D, E or F for galvanized deck or Engineer approved equal, having a minimum yield strength of 33,000 PSI.

2.3 FINISH

- A. Galvanizing: Steel deck shall be galvanized with a protective zinc coating conforming to ASTM A525 G60 class.

2.4 ROOF DECK ACCESSORIES

Provide minimum 20 gauge ridge and valley plates, minimum 20 gauge cant strips, minimum 14 gauge sump pans, minimum 20 gauge inside or outside closure channels, minimum 20 gauge butt strips at change of deck directions, minimum 20 gauge filler sheets, and rubber closures as required to provide a finished surface for the application of insulation and roofing.

2.5 FABRICATION

- A. Metal Deck Spans: Metal deck spans shall not exceed the maximum center-to-center spans as required by SDI criteria. Where possible, all metal deck shall extend over three or more supports.

- B. Metal Closure Strips: Fabricate metal closure strips of not less than 0.071" minimum (14 gage) cold-formed sheet steel. Form to provide tight fitting closures at open ends of cells or flutes and sides of decking. Provide sheet metal closures at all slab edges, columns, walls, and openings unless steel angles or bent plates are specified in details on the drawings. Also, provide wherever deck stops or changes direction. Weld closures at edge supports with 1" long weld at 12" maximum centers unless shown otherwise on the drawings. Provide minimum 2" bearing over steel support. Closures and support welds shall be designed to support a 200 pound concentrated load at the roof edge without exceeding a stress of 0.8 Fy.

2.6 ROOF OPENINGS

Roof openings less than 6" square or diameter require no reinforcement. Openings 6" to 10" inclusive shall be reinforced with a 20 gauge galvanized plate welded to the deck at each corner and 6" maximum centers with a 5/8" diameter puddle weld or sheet metal screws. Larger openings shall be referred to the Engineer for framing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install deck units as accessories in accordance with manufacturers recommendations and approved shop drawings, and as specified herein:
1. Place deck units on supporting framework and adjust to final position with ends accurately aligned and bearing 2" minimum on supporting members before being permanently fastened. Do not stretch or contract side lap interlocks.
 2. Place deck units in straight alignment for entire length of run of cells and with close alignment between cells at ends of abutting units.
 3. Place deck units flat and square, secured to adjacent framing without warp or excessive deflection.
 4. Do not place deck units on concrete supporting structure until concrete has cured and is dry.
 5. Coordinate and cooperate with structural steel erector in locating decking bundles to prevent overloading of structural members.
 6. Do not use roof deck units for storage or working platforms until permanently secured.
- B. Attachment of Roof Deck:
1. Welding:

- a. Typical Requirements: Roof deck units shall be welded to each structural support member using 5/8" diameter puddle welds at spacing shown on Typical Detail on plans. Weld metal shall penetrate all layers of deck material at end laps and side joints and shall have good fusion to the supporting members.
 - b. Side Laps: Side laps of adjacent units shall be fastened by sheet metal screws at spacing shown on Typical Detail on plans.
 - c. Welding Washers: Welding washers shall be used only when welding steel deck less than 0.028" thickness.
2. Minimum Bearing: Provide a minimum end bearing of 3" over supports.
 3. End Laps: End laps of sheets shall be a minimum of two inches and shall occur over supports. Roofs having a slope of 1/4 inch or more in 12 inches shall be erected beginning at the low side to insure that end laps are shingle fashion.
- C. Welding Requirements: Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work.
- D. Cutting and Fitting: Cut and neatly fit deck units and accessories around other work projecting through or adjacent to the decking.
- E. Reinforcement at Openings: Provide additional metal reinforcement and closure pieces as required for strength continuity of decking and support of other work shown on the drawings.
- F. Hanger Slots or Clips: Provide UL approved punched hanger slots between cells or flutes of lower element where roof deck units are to receive hangers for support of ceiling construction, air ducts, diffusers, or lighting fixtures.
1. Hanger clips designed to clip over male side lap joints of roof deck units may be used instead of hanger slots.
 2. Locate slots or clips at not more than 14" o.c. in both directions, not over 9" from walls at ends, and not more than 12" from walls at sides, unless otherwise shown.
 3. Provide manufacturer's standard hanger attachment devices.
 4. Loads hanging from metal deck slabs shall not exceed 100 pounds unless specifically detailed otherwise on the drawings.
- G. Joint Covers: Provide metal joint covers at abutting ends and changes in direction of deck units, except where taped joints are specified.

3.2 TOUCH-UP PAINTING

After deck installation, wire brush, clean and paint scarred areas, welds and rust spots on top and bottom surfaces of decking units and supporting steel members.

Touch-up galvanized surfaces with galvanizing repair paint applied in accordance with manufacturer's instructions.

Touch-up painted surfaces with same type of shop paint used on adjacent surfaces.

In areas where shop-painted surfaces are to be exposed, apply touch-up paint to blend into adjacent surfaces.

3.3 INSPECTION

Welded decking in place is subject to inspection and testing by the Owner's Testing Laboratory. Expense of removing and replacing portions of decking for testing purposes will be borne by Owner if welds are found to be satisfactory. Remove work found to be defective and replace with new acceptable work. Cost of such removal and replacement shall be borne by the Contractor.

END OF SECTION 05 31 00

SECTION 053120 - STEEL FORM DECK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 1 - Specification sections, apply to work of this section.

1.2 SCOPE OF WORK

A Supplier: The metal deck supplier shall furnish all metal deck materials and accessories indicated on the Architectural, Structural, and Mechanical Drawings required to produce a complete job including but not necessarily limited to deck units, cover plates, pour stops, metal deck edge closures, cell closures, cant strips, sump pans, and all related accessories.

B Erector: The Subcontractor responsible for erecting the metal deck shall provide all labor and equipment as required to place all metal deck components and accessories as described above.

1.3 QUALIFICATIONS

The metal deck supplier shall be a manufacturer with a minimum of two years successful experience and with a minimum of two successful jobs of a comparable size and scope to this project.

1.4 QUALITY ASSURANCE

The Contractor is responsible for quality control, including workmanship and materials furnished by his subcontractors and suppliers.

A Codes and Standards: Comply with provisions of the following codes and standards except as otherwise indicated or specified:

- 1 "Design Manual for Composite Decks, Form Decks, and Roof Decks", as published by the Steel Deck Institute (SDI).
- 2 "Specification for the Design of Cold Formed Steel Structural Members", as published by the American Iron and Steel Institute (AISI).
- 3 "Structural Welding Code - Steel", as published by the American Welding Society (AWS).

B Qualification of Field Welding: Qualify welding processes and welding operators in accordance with AWS procedures.

- C Underwriters Label: Provide metal deck units which are listed and conform to Underwriters Laboratories "Fire Resistance Directory", with each deck unit bearing the UL label and marking for specific system detailed. Provide units and construction, which are found in UL "Building Materials Directory" and conform to UL Uplift Class 90 construction.
- D Factory Mutual Listing: Provide metal roof deck units which have been evaluated by Factory Mutual System and are listed in "Factory Mutual Approval Guide" for "Class I" fire rated construction and "I-90" windstorm construction.

1.5 SUBMITTALS

- A Product Certification: Submit manufacturer's specifications and installation instructions for each type of deck specified. Also submit a certificate of product compliance with SDI Standards as specified.
- B Shop Drawings: Submit detailed shop drawings showing type of deck, complete layout, attachment details, closures, edge strips, supplementary framing, and all other accessories.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

See General Notes on the drawings for location of metal deck types and for depth of deck, minimum deck thickness, section properties of deck, concrete type, total slab thickness, slab reinforcement, and suggested manufacturer.

Acceptable deck manufacturers include the following:

Vulcraft/Div. Nucor Corp.
Wheeling Corrugating Co.
United Steel Deck, Inc.

Other manufacturers may be used only with Architect/Engineer approval.

2.2 GRADES OF STEEL

Steel Form Deck shall be manufactured from steel conforming to ASTM A611 Grades C, D, or E or ASTM A446 Grades A, B, C, D or E having a minimum yield strength of 33,000 PSI. The delivered thickness of uncoated steel shall not be less than 95% of the design thickness. Sheet metal accessories shall conform to ASTM A526, commercial quality.

2.3 FINISH

- A Floor Deck:

- 1) Galvanized: Floor deck shall be galvanized with a protective zinc coating conforming to ASTM A525 G90 class.
- B Galvanizing Repair Paint: High zinc-dust content paint for repair of damaged galvanizing surfaces complying with Military Specifications MIL-P-21035 (Ships).

2.4 FABRICATION

- A Metal Deck Spans: Metal deck spans shall not exceed the maximum center-to-center spans as required by SDI criteria. Where possible, all metal deck shall extend over 3 or more spans.
- B Metal Closure Strips: Fabricate metal closure strips of not less than 0.071" minimum (14 gage) cold formed sheet steel. Form to provide tight fitting closures at open ends of cells or flutes and sides of decking. Provide sheet metal closures at all slab edges, columns, walls, and openings unless steel angles or bent plates are specified in details on the drawings. Also, provide wherever deck stops or changes direction. Weld closures at edge supports with 1" long weld at 12" maximum centers unless shown otherwise on the drawings. Provide minimum 2" bearing over steel support. Closures and support welds shall be designed to support the wet weight of concrete and a 150 pound concentrated load acting at the slab edge without exceeding a stress of 0.8 Fy; and the wet concrete weight alone without exceeding a stress of 0.6 Fy and a deflection of 3/4" maximum.

2.5 FLOOR SLAB REINFORCEMENT

- A Placement of Slab Reinforcement:
 - 1 Slabs with total thickness three inches or less shall have reinforcement placed in the center of the slab half way between top of metal deck and slab top surface. Provide a continuous #5 reinforcing bar over each steel support. #5 bars shall be chaired (CRSI Type HCM high chair) from bottom of deck with bar securely tied to welded wire fabric at 48" on center.

2.6 FLOOR OPENINGS

For all openings in metal deck not framed with structural steel and greater than 10" in width in either direction, provide 1 - #5 x opening width + 1'-0" in a direction perpendicular to deck ribs each side of opening with bars bearing on top of ribs and 1 - #5 x deck span + 1'-0" each side of opening chaired 3/4" up from bottom of nearest deck rib running beside the opening from support to support. Provide blackout in slab for opening with deck uncut. Cut deck at opening after concrete has been poured and obtained 75% of its design strength.

2.7 CHLORIDE ADMIXTURES

The use of admixtures in concrete containing chloride salts shall not be permitted for metal deck concrete.

2.8 EXTRA CONCRETE REQUIRED FOR DECK DEFLECTION

The General Contractor shall include in his bid additional concrete required for metal deck slabs to account for deck deflection.

PART 3 - EXECUTION

3.1 INSTALLATION

A General: Install deck units as accessories in accordance with manufacturers recommendations and approved shop drawings, and as specified herein:

- 1 Place deck units on supporting framework and adjust to final position with ends accurately aligned and bearing 2" minimum on supporting members before being permanently fastened. Do not stretch or contract side lap interlocks.
- 2 Place deck units in straight alignment for entire length of run of cells and with close alignment between cells at ends of abutting units.
- 3 Place deck units flat and square, secured to adjacent framing without warp or excessive deflection.
- 4 Do not place deck units on concrete supporting structure until concrete has cured and is dry.
- 5 Coordinate and cooperate with structural steel erector in locating decking bundles to prevent overloading of structural members.
- 6 Do not use floor deck units for storage or working platforms until permanently secured.

B Attachment of Form Deck:

- 1 Welding - Floor Deck:
 - a Floor deck units shall be screwed to each support. Deck units shall be screwed at each side lap.
- 2 Minimum Bearing: Provide a minimum end bearing of 2" over supports.

- 3 End Laps: End lap of sheets shall be a minimum of two inches and shall occur over supports.
- C Cutting and Fitting: Cut and neatly fit deck units and accessories around other work projecting through or adjacent to the decking.
- E Reinforcement at Openings: Provide additional metal reinforcement and closure pieces as required for strength continuity of decking and support of other work shown on the drawings.
- F Hanger Slots or Clips: Provide UL approved punched hanger slots between cells or flutes of lower element where floor deck units are to receive hangers for support of ceiling construction, air ducts, diffusers, or lighting fixtures.
 - 1 Hanger clips designed to clip over male side lap joints of floor deck units may be used instead of hanger slots.
 - 2 Locate slots or clips at not more than 14" o.c. in both directions, not over 9" from walls at ends, and not more than 12" from walls at sides, unless otherwise shown.
 - 3 Provide manufacturer's standard hanger attachment devices.
 - 4 Loads hanging from metal deck slabs shall not exceed 100 pounds unless specifically detailed otherwise on the drawings.
- G Joint Covers: Provide metal joint covers at abutting ends and changes in direction of deck units, except where taped joints are specified.

3.2 TOUCH-UP PAINTING

After deck installation, wire brush, clean and paint scarred areas, welds and rust spots on top and bottom surfaces of decking units and supporting steel members.

Touch-up galvanized surfaces with galvanizing repair paint applied in accordance with manufacturer's instructions.

Touch-up painted surfaces with same type of shop paint used on adjacent surfaces.

In areas where shop-painted surfaces are to be exposed, apply touch-up paint to blend into adjacent surfaces.

3.3 INSPECTION

Welded decking in place is subject to inspection and testing by the Owner's Testing Laboratory. Expense of removing and replacing portions of decking for testing purposes will be borne by Owner if welds are found to be satisfactory. Remove work found to be defective and replace with new acceptable work. Cost of such removal and replacement shall be borne by the Contractor.

END OF SECTION 05 31 20

SECTION 05 40 00 - COLDFORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

A. Extent of coldformed metal framing used as structural support for exterior cladding is shown on the drawings.

B. Types of coldformed metal framing units include the following:

1. Non-load bearing studs

1.3 QUALITY ASSURANCE

A. Component Design: Compute structural properties of studs and joists in accordance with "Specification for Design of Cold-Formed Steel Structural Members" latest edition, as published by the American Iron & Steel Institute (AISI).

B. Codes and Standards:

1. "Structural Welding Code - Sheet Steel", AWS D1.3 as published by the American Welding Society (AWS).
2. "Recommended Practices for Resistance Welding Coated Low Carbon Steels", AWS C1.3, as published by the American Welding Society.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's product information and installation instructions for each item of coldformed framing and accessories.

B. Shop Drawings: Submit P.E. sealed shop drawings for all coldformed metal framing used to support exterior cladding. Shop drawings shall indicate placing of all framing members showing type, size, gage, number, location and spacing. They shall also indicate supplemental strapping, bracing, splices, bridging, accessories and details required for proper installation. Shop drawings must indicate type of fastening system used along with size and number of fasteners.

1. Welded connections shall show size and length of welds for all connections.

2. Screwed connections shall show type, size, and number of screws for all connections. Submit manufacturers data giving strength values for screws used. The Engineer of record will not be responsible for coldformed metal framing erected without approved shop drawings.
3. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 DELIVERY AND STORAGE

Protect metal framing units from rusting and damage. Deliver to project site in manufacturer's unopened containers or bundles, fully identified with name, brand, type and grade. Store off ground in a dry ventilated space or protect with suitable waterproof coverings.

PART 2 - PRODUCTS

2.1 SYSTEM COMPONENT

With each type of metal framing indicated on the Architectural or Structural Drawings, provide manufacturer's standard steel runners (tracks), blocking, lintels, clip angles, shoes, reinforcements, fasteners and accessories as recommended by the manufacturer for applications indicated, as needed to provide a complete metal framing system.

2.2 GRADES OF STEEL

- A. For 16-gage and heavier units, fabricate metal framing components of structural quality steel sheet with a minimum yield point of 50,000 psi and conform to ASTM A 446 and/or A 570.
- B. For 18-gage and lighter units, fabricate metal framing components of structural quality steel sheet with a minimum yield point of 33,000 psi and conform to ASTM A 446 and/or A 570.

2.3 FINISH

- A. Provide galvanized finish to all metal framing components complying with ASTM A 525 for minimum G60 coating.

2.4 FABRICATION

- A. General: Framing components may be prefabricated into panels prior to erection. Fabricate panels plumb, square, true to line and braced against racking with joints welded. Perform lifting of prefabricated panels in a manner to prevent damage or distortion.
- B. Connections:

1. Type: Connection of coldformed metal components shall be as indicated on the drawings.
2. Design Forces: Connections of members shall develop the full allowable tensile force of the members connected unless calculations are submitted substantiating lower forces.
3. Welded Connections: Connection of coldformed metal components shall be made using arc welding or resistance welding methods. All welding shall be performed in accordance with the latest recommended procedures and practices of the American Welding Society, AWS C1.3 "Recommended Practices for Resistance Welding Coated Low Carbon Steels" and AWS D1.3 "Specification for Welding Sheet Steel in Structures". Welding process along with weld sizes and lengths necessary to develop the member forces specified shall be shown on the shop drawings. Protection of the weld area after welding shall be accomplished using a zinc-rich galvanizing repair paint.
4. Wire tying of framing components in structural applications shall not be permitted.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION

Pre-Installation Conference: Prior to start of installation of metal framing systems, meet at project site with installers of other work including door and window frames and mechanical and electrical work. Review areas of potential interference and conflicts, and coordinate layout and support provisions for interfacing work.

3.2 INSTALLATION

- A. Manufacturer's Instructions: Install metal framing systems in accordance with manufacturer's printed or written instructions and recommendations, unless otherwise indicated.
- B. Runner Tracks: Install continuous tracks sized to match studs. Align tracks accurately to layout at base and tops of studs. Secure tracks as recommended by stud manufacturer for type of construction involved, except do not exceed 24" o.c. spacing for nail or powder-driven fasteners, or 16" o.c. for other types of attachment. Abutting pieces of track shall be securely spliced together. Provide fasteners at corners and ends of tracks.
- C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements. Splices in axially loaded and non-loaded bearing exterior cladding stud systems shall not be permitted.

- D. Provide four (4) studs at each intersecting wall and three (3) studs at each corner.
- E. Where stud system abuts structural columns or walls, anchor ends of stiffeners to supporting structure.
- F. Install supplementary framing, blocking and bracing in metal framing system wherever walls or partitions are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings, and similar work requiring attachment to the wall or partition. Where type of supplementary support is not otherwise indicated, comply with stud manufacturer's recommendations and industry standards in each case, considering weight or loading resulting from item supported.
- G. Installation of Wall Stud System: Studs shall be seated firmly against the track webs allowing load transfer by direct bearing without complete dependence on the connection to the track. Connect studs to top and bottom runner tracks by either welding or screw fastening as indicated on the drawings at both inside and outside flanges.
- H. Frame wall openings larger than 2'-0" square with double stud at each jamb of frame except where more than 2 are either shown or indicated in manufacturer's instructions. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with stud shoes or by welding, and space jack studs same as full-height studs of wall. Secure stud system wall opening frame in manner indicated.
- I. Frame both sides of expansion and control joints, with separate studs; do not bridge the joint with components of stud system.
- J. Horizontal Bridging:
 - 1. Install horizontal bridging in all stud systems, spaced (vertical distance) at not more than 4'-0" o.c.
 - 2. Provide stud bracing during construction as required for studs to carry construction loads.
- K. Sheathing Attachment: Provide attachment of interior and exterior sheathing and wall material to each stud in accordance with AISI Specification.

END OF SECTION 05 40 00

SECTION 05 50 00 – METAL FABRICATIONS

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

SCOPE

- A. Furnish all materials, labor and equipment shown on the drawings, specified herein or required for completion of the work.

MATERIALS

- A. Unless noted otherwise on the plans, all structural steel shall comply with ASTM A36, latest edition and amendments.

SUBMITTALS

- A. Provide completely detailed shop drawings showing anchorage placement, member placement and erection plans indicating all member sizes, locations, bridging, bracing, connections, methods of assembly, etc. The Contractor shall carefully check these drawings, then submit them to the Architect. The Architect may conduct limited spot checks aimed solely at determining general comprehension of the work detailed, then return them to the Contractor. The Contractor shall then carefully re-check the drawings and approve them prior to fabrication.
- B. The Architect's spot check does not relieve the Contractor from correcting, at his own expense, any work or re-fabricating items which may be found not to comply with the requirements and intent of the plans and specifications.

DELIVERY, STORAGE AND HANDLING

- A. Inspection: Accept metal fabrications on-site in labeled shipments. Inspect for damage.
- B. Protect metal fabrications from damage by exposure to weather or by ground contact.

EXISTING CONDITIONS

- A. Field Measure prior to fabrication. Indicate field measurements on Shop Drawings.

FABRICATION & ERECTION

- A. Comply with requirements of the Manual of Steel Construction, Specifications for Buildings as amended to date, and the Code of Standard Practice, latest edition as adopted by the American Institute of Steel Construction. Welding shall comply with Standard Code of Arc and Gas Welding in Building Construction as published by the American Welding Society, except that all welding is by the electric arc process.
- B. Welds shall be made only by welders and welding operators who have been qualified within the preceding 12 months by tests as prescribed in the Standard Code for Welding in Building Construction of the American Welding Society, to perform the type of welding required. All welders working on the project shall be assigned an identifying symbol to be placed on or near each weld for identification. The Contractor shall maintain a record of all welders employed, date of qualification and identification symbol assigned to each.

- C. Field correcting or altering by “torching”, or otherwise, shall not be permitted unless prior approval is obtained from the Architect or Engineer. This applies to fabrication errors as well as work to accommodate other trades. Any errors which prevent the proper assembly of parts or components as detailed shall be reported to the fabricator for correction.

WELDS

- A. All welds shall be full penetration fillet welds.
- B. Grind all welds smooth prior to priming or galvanizing.

PAINTING

- A. Steel to be primed shall receive a shop primer coat of Sherwin-Williams “KROMIK”, Pittsburgh “IRONHIDE”, Negley “ZINC CHROMATE RUST INHIBITIVE PAINT”, or equal. After erection, all field welds, bolts, and abraded areas of surfaces shall receive a touch-up of the same paint as the shop primer coat.

MISCELLANEOUS METAL ITEMS

1. ROOF ACCESS LADDERS (INTERIOR):

- A. Ladders to be fabricated using standard steel pipe rails with bent plate brackets and manufactured rung and rung covers as detailed on the drawings.
- B. Shop prime and touch-up after erection as specified above.

2. STEEL LINTELS:

- A. Fabricate from steel angles as detailed on the drawings. Unless shown otherwise, length shall be 1'-4" wider than the brick opening being spanned. For openings greater than 5'-0", verify length of lintel with structural engineer.
- B. Hot-dip galvanize after fabrication. Paint to match exterior veneer masonry.

3. BOLLARDS:

- A. Fabricate bollards from steel pipe, plates and other components as detailed on the drawings.
- B. Shop prime and touch-up after erection as specified above or hot-dip galvanize after fabrication. Refer to notes on drawings.

4. HANDRAIL BRACKETS:

- A. Brackets shall be wall type. Include all other components required for finished installation. All work shall comply with local codes and Texas Accessibility Standards (TAS).
- B. Shop prime and touch-up after erection as specified above. Make sure all components are clean and smooth before priming. Hot-dip galvanize at exterior applications.

5. STRUCTURAL SUPPORTS

- A. Other structural supports, steel sections, shape and size as indicated on Drawings required to support applied loads with maximum deflection of 1/240 of span; prime paint, one coat at interior applications. Hot-dip galvanize at exterior applications.

9. DOWNSPOUT BOOTS

- A. Minimum 11 gauge hot-dipped galvanized, painted 5" x 5" x 60" high except where larger size is required for downspout. Provide with minimum 4 predrilled tabs for bolting to exterior wall.

10. BELL TOWER BIRD SCREEN:

- A. Bird screen to be fabricated using standard aluminum tubes and angles as detailed on the drawings. Wire mesh to be as indicated on drawings.
- B. Finish to match exterior aluminum storefront system color.

11. DECORTIVE TRUSS:

- A. Truss to be fabricated using standard steel tubes and angles as detailed on the drawings. All welds to be continuous and shall be ground smooth.
- B. Shop prime and touch-up after erection as specified above. Paint as indicated on drawings.

NON - SHRINKING GROUT

- A. Use non-shrinking grout as indicated on the plans. Use Master Builders Company "EMBECO", Sonneborn Chemical & Refining Corporation's "SONOGROUT 14K", or equal, mixed according to the manufacturer's written instructions.

MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports that are not a part of the structural steel framework as necessary to complete work.
- B. Fabricate units from structural steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

MISCELLANEOUS

- A. Furnishing bolts, anchors, inserts, drive pins, expansion shields, lag screws, ramset fasteners, toggle bolts, dovetail anchors and other fastening devices as required and/or indicated on the drawings necessary for the fastening of wood nailing and stripping and furring members to each other and to masonry, concrete or other adjoining materials needed to complete the work is an obligation of the General Contractor, and he shall be responsible for their furnishing and erection whether they are mentioned in other divisions of these specifications or not.

END OF SECTION 05 50 00

SECTION 06 10 00 – ROUGH CARPENTRY

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

SECTION INCLUDES

- A. All rough carpentry items including, but not limited to:
 - 1. Wood blocking for support of items supported on or recessed into wood framing or requiring wood blocking for support.
 - 2. Wood cants, nailers, curbs, and other items associated with roofing work.
 - 3. Miscellaneous framing items and plywood sheathing.

RELATED WORK

- A. All Sections of Work supported on or recessed into wood framing or requiring wood blocking for support, such as wall trim, wall cabinets, handrails, stations of the cross, crucifixes, toilet compartments, toilet accessories, fire extinguisher cabinets, etc., as applicable to the Project.

LUMBER GRADING

- A. Each piece of plywood used shall carry the American Plywood Association trademark.
- B. Grading Rules: Conform with all applicable requirements of American Lumber Standards “Simplified Practice Recommendations R-16” and to grading rules of manufacturer’s association under whose rules the lumber is produced.
- C. Reference Standards: Conform with all requirements.
 - 1. U.S. Dept. of Commerce Product Standards (PS)
 - 2. American Plywood Association (APA)
 - a. Standards and Construction Guide
 - 3. American Wood Preservers Association (AWPA)
 - a. Standards, as they apply.
 - 4. Architectural Woodwork Institute (AWI)
 - a. Quality Standards
 - 5. National Woodwork Manufacturers Association (NWMA)
 - a. Standards
 - 6. Western Wood Products Association (WWPA)
 - a. Manual

LUMBER

- A. Lumber:
 - 1. Treated No. 2 S4S Southern Yellow Pine, #1 kiln dried.
 - a. Comply with NWMA Standards
 - b. Use for blocking, stripping, grounds, cants and miscellaneous wood items in contact with concrete, roofing, or exposed to the weather.
 - 2. No. 2, S4S Southern Yellow Pine: Use for framing, blocking, stripping and miscellaneous concealed interior lumber not exposed to concrete, roofing weather or moisture, when FRS lumber is not required by building code.
 - 3. Fire Retardant No. 2, S4S Southern Pine: Refer to Fire Retardant Treatment below. Use for framing, plates and blocking in all walls and partitions where required by building code or noted on drawings.

B. Plywood:

1. General: Comply with APA Standards.
2. APA A-D, Group 1 interior used where appearance of only one side is exposed to view for interior locations. Use for wall liner at MDF/IDF closets and telephone boards in mechanical and electrical rooms where shown or required. 3/4 inch thick unless required or shown otherwise. Paint as scheduled.
3. Exterior plywood, Group 1, APA rated sheathing. Use where miscellaneous plywood is exposed to concrete, weather, or at roof construction as sheathing.
4. Fire Retardant Treated Plywood: Refer to Fire Retardant Treatment below. Use when required by building code or noted on drawings.
5. Underlayment: If shown or required, APA rated Sturdi-floor, exterior grade, tongue and groove edges.

C. Wood Treatment:

1. Preservative Treatment (Concealed Conditions):
 - a. Borage: Pressure impregnated preservative to net retention of 0.28lbs/cu.ft., in plant licensed by manufacturer in accordance with the following standards:
 1. Preservative Treatment Standard: AWPA P5\
 2. Structural Lumber Treatment Standard: AWPA C31
 3. Plywood Treatment Standard: AWPA C9
 - b. Brush two (2) coats of preservative on bored or sawn surfaces of treated lumber.
 - c. Provide Quality Mark Stamp or end tag identifying third party inspection agency on treated wood for identification.
 - d. Concealed conditions mean conditions that are interior, above ground that are not exposed to direct standing water, in contact with natural grade, or exposed to weather.
 - e. ACQ and CCA preservatives not permitted.
 - f. Acceptable Manufacturers: Osmose "Advance Guard"; Universal Forest Products "Prowood Borate"; or Architect approved equal.
2. Fire Retardant Treatment:
 - a. Lumber shall be pressure-impregnated with non-combustible fire retardant chemicals in accordance with U.L. FRS Fire Hazard Classification. All lumber must be dried following treatment in accordance with AWPA Standard C20.
 - b. Plywood shall be pressure-impregnated with non-combustible fire retardant chemicals in accordance with U.L. FRS Fire Hazard Classification. All plywood must be dried following treatment in accordance with AWPA Standards C27.

- D. Refer to Structural Drawings for notes relative to wood framing as well. Any wood types or structural properties referred to specifically on the structural drawings supersede these specifications.

INSTALLATION

A. Wood Framing:

1. Framing and blocking shall be accurately cut and fitted true to line and levels, avoiding shims and wedges.
2. Spiking and nailing shall be done using largest size spikes and nails.
3. Unless otherwise shown, use 2 inch by 4 inch wood studs spaced 16 inches o.c. bottom plate and double-top plates 2 inches thick by width of studs.
4. Bolt nailers and blocking to steel, masonry or concrete members with bolts or proportionate strength of members attached from each end, except as otherwise noted on plans.

5. Provide blocking, bucks and framing as necessary and for other trades as required.
6. Drill lumber accurately for bolts and fit all bolts with suitable washers.

B. Plywood:

1. Install plywood over framing in accordance with instruction of American Plywood Association Construction Guide From No. E30C.
2. Install underlayment plywood as shown in accordance with instruction of American Plywood Association. Space panel joints and edges 1/32 inch. Fill and sand panel edge joints, surface roughness, and damaged or open areas. Nail with 4d ring-shank nails spaced at six (6) inches at edges and eight (8) inches in field each way.

- C. Treated fascia, curbs, cant strips, nailers, etc., shall be nailed or bolted as shown on the drawings and set straight and even.
- D. Parapet cap blocking, window and door bucks and blocking, nailers, etc., shall be screwed, nailed, bolted or attached with drive-pin fasteners as shown on the drawings and set straight and even.
- E. Bolts or other fasteners shall be placed a maximum of 18" from the end of all pieces.

ROUGH HARDWARE

- A. Use common nails, typically, but countersunk wood screws for all tension joints.
- B. All fasteners and other hardware exposed to weather shall have a galvanized finish. Refer to literature provided by manufacturer of pressure treated lumber and provide finishes on all fasteners used for treated lumber that are approved by the manufacturer to resist corrosion due to contact with chemicals used in the wood treatment process.
- C. Bolts and other anchors shall have a minimum 3/8" diameter unless shown otherwise. Provide washers when securing wood. Bolts and anchors shall have galvanized finish when used in exterior exposure, exterior wall construction or placed in slabs on grade. Provide the proper type of bolt or anchor, i.e., bolt and nut, toggle bolt, expansion bolt, bolt and lead shield, lag screws, etc., as required by condition of use.
- D. Refer to Structural Drawings for notes relative to fasteners, joist hangers or other special hardware needed when adding additional lumber members to strengthen existing structural components of the building.
- E. Unless shown otherwise on the drawings all nailing and fastening of framing members shall at a minimum be in accordance with Table 2304.9.1, Fastening Schedule, in the 2018 International Building Code.

WORKMANSHIP

- A. Carefully plan and lay out all work as required to carry out the intent of the contract documents. Coordinate with other trades requiring stripping, blocking, nailers, etc., and locate these items as required to properly accommodate their work.

END OF SECTION 06 10 00

SECTION 06 20 00 – FINISH CARPENTRY

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

SECTION INCLUDES

- A. Providing all finish carpentry items including, but not limited to:
 - 1. Finish Carpentry
 - 2. Millwork and Cabinetry
 - 3. Plastic Laminate
 - 4. Casework Hardware
 - 5. Miscellaneous Millwork.
 - 6. Wood Paneling

REFERENCE SPECIFICATIONS

- A. Work under this section shall be governed by “Quality Standards of the Architectural Woodwork Industry”, AWI (Latest Edition), Premium Grade except when another grade is specifically referenced.
- B. Fabricator must demonstrate a minimum of five (5) years experience in manufacture of architectural woodwork that complies with AWI Standards.

SUBMITTALS

- A. Product Data:
 - 1. Manufacturer’s specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer’s preprinted product information for all hardware proposed on the project.
 - 3. Manufacturer’s preprinted maintenance instructions for the casework hardware.
- B. Shop Drawings:
 - 1. Indicate size, material and finish.
 - 2. Show locations and installation procedures, including hardware, sinks, service fixtures, trim and other pertinent data for each unit.
- C. Certification: Provide AWI Quality Certification Program certification for casework fabrication and installation, or upon awarding of the work, register the work under this section with the AWI Certification Program.
- D. Samples: Two (2) each, 6 inch by 6 inch by 3/4 inch sample of specified particleboard core with grade stamp for use as verification of installed product.

WOOD FLOORING

- A. Manufacturer listed below is the basis-of-design and is listed for the Contractor’s convenience only and shall not preclude the Contractor from using other manufacturers, provided they produce equivalent products of the type specified for the scope and size of the Project. Other manufacturers must have experience manufacturing products meeting or exceeding the specifications and must comply with the criteria specified above and in Division 1 requirements regarding substitutions.
 - 1. Engineered Hardwood Flooring:

- a. Manufacturer: Hartco
- b. Type: Dogwood Pro
- c. Wood Species: White Oak
- d. Surface Texture: Enhanced Wire Brush
- e. Color Shade: Natural
- f. Width: 6 1/2"
- g. Thickness 3/8"
- h. Length: 10" – 60"
- i. Construction: Engineered Hardwood
- j. Finish: Urethane
- k. Edge: Micro
- l. Warranty: 10 years
- m. Installation: Glue Down
- n. Recommended Adhesives: Bruce ProConnect, Bruce Equalizer Pro, Bruce Summit Select

2. Engineered Hardwood Stair Nosing:

- a. Manufacturer: Hartco
- b. Type: Dogwood
- c. Wood Species: White Oak
- d. Color Shade: Natural
- e. Width: 2.75"
- f. Thickness 3/8"
- g. Length: 78"
- h. Construction: Engineered Hardwood
- i. Installation: Glue Down
- j. Recommended Adhesives: Bruce ProConnect, Bruce Equalizer Pro, Bruce Summit Select

3. Engineered Hardwood Stair Riser:

- a. Manufacturer: Hartco
- b. Type: Dogwood Pro
- c. Wood Species: Red Oak
- d. Surface Texture: Enhanced Wire Brush
- e. Color Shade: Saddle
- f. Width: 6 1/2"
- g. Thickness 3/8"
- h. Length: 10" – 60"
- i. Construction: Engineered Hardwood
- j. Finish: Urethane
- k. Edge: Micro
- l. Warranty: 10 years
- m. Installation: Glue Down
- n. Recommended Adhesives: Bruce ProConnect, Bruce Equalizer Pro, Bruce Summit Select

B. HANDLING: It is understood that wood products are sensitive to moisture, temperature and humidity, Boards must be stored inside in the area to be installed not in unclimatized buildings, garages, sheds, directly on bare concrete or next to outside walls. It is important to keep wood flooring dry, protect the flooring from rain or snow during transportation. Lay the flooring flat in a dry level place. Provide air flow under and around cartons. Cartons should be placed close to the center of the installation area as possible. Keep out of direct sunlight and away from heat/air vents. To prevent board warping, twisting or bowing do not cut the plastic support packaged bindings or remove product from the packaging until ready to install.

- C. **INSTALLER RESPONSIBILITIES:** Before beginning the installation first determine if the job site and subfloor conditions are acceptable. The environment, weather fluctuations and product storage can adversely affect all organic materials. The installer is responsible for final inspection of quality. During installation, use reasonable board selectivity and good judgment. From a standing position any individual board deemed unacceptable in appearance should not be used. Defects should be cut off and discarded. To minimize gapping, boards of similar widths should be placed together in the same row.
- D. **JOB SITE INSPECTION:** The yard around the work space should be graded to allow water to run away from the building. The building must be enclosed. To prevent moisture related issues such as buckling or cupping, all wet trades involving water or moisture (plumbing, ceramic tiles, drywall finishes, painting, etc.) should be finished with ample time allowed for complete drying prior to wood floor installation. For best performance, wood boards should be one of the last items installed. (HVAC)Heating, Ventilation and or Air conditioning systems should be fully operating and running with temperature between 60F and 80F, with humidity between 30% and 50%, at least 5 days before delivery.
- E. **ACCLIMATION/CONDITIONING:** During transit, delivery and storage, wood flooring must be protected from moisture. First, acclimate the new flooring in the areas to be installed to the expected environment that the floor will service while in the boxes. If products are packaged in plastic, remove the plastic wrapping from the outside of the boxes to speed up the acclimation process increasing air-flow. The length of acclimation time is not the determining factor. The goal is to reach a moisture balance between the wood and its normal indoor surroundings before assembly, fastening or installation. For best performance, condition and maintain the wood to consistent indoor temperatures of 60°-80° F and indoor humidity levels of 30% -50%, before, during and after installation. Depending on your local conditions the use of a dehumidifier or a humidifier may be necessary to maintain the desired results. Very dry or humid regions of the country usually require extended conditioning to balance the wood to the environment it will service. Proper jobsite conditions, acclimation, moisture testing of the substrate and wood all work together for the success of the installation, and is the responsibility of the installer. Not following the above recommendations can negatively impact board performance and can result in excessive movement, squeaks, board gapping, board-edge cupping, finish splits and other related issues.
- F. **INSTALLATION (GLUE-DOWN):** Follow manufactures instructions and recommendations for glue down installation.

CASEWORK

- A. Manufacturer's listed below are listed for the Contractor's convenience only and shall not preclude the Contractor from using other manufacturers, provided they produce equivalent products of the type specified for the scope and size of the Project. Other manufacturers must have experience manufacturing products meeting or exceeding the specifications and must comply with the criteria specified above and in Division 1 requirements regarding substitutions.
1. Casework:
 - a. Ameritek Design Inc., Houston, TX (281) 442-7767
 - b. Global Casework Manufacturing, Inc., Sugarland, TX (281) 494-9300
 - c. Imperial Mill & Fixture, Inc. Corpus Christi, TX (361) 883-4630
 - d. Jericho Woodworks, Sugarland, TX (281) 313-5780
 - e. J's Cabinet Work, Houston, TX (713) 206-0925
 - f. Goebel Woodwork, Cuero, TX (361) 277-5220
 - g. MGC Millwork, LP, Stafford, TX (281) 340-1400
 - h. Robert Shaw Mfg. Co., Inc. Fort Worth, TX (817) 927-2557
 - i. LSI Corporation of America, Inc. Minneapolis, MN (763) 559-4664

MILLWORK MATERIALS

SOLID STOCK WOOD

- A. Stain grade, base, wall trim, door trim, window trim, cabinet style, rail, trim, banding, drawer faces, corner blocks, handrails, chair railing, etc. and other pieces as detailed on the drawings shall be S4S, select maple, grade 1.
- B. Stained decorative ornaments, railings, wood caps, etc. as detailed on the drawings shall be cut from S4S, select maple, grade 1.
- C. Mill all solid stock wood to sizes and shapes as detailed on the drawings, use longest lengths possible and miter corners and joints.
- D. Paint grade wall trim, etc. shall be S4S, C & better grade, fir, poplar or parana pine.
- E. Moisture content at time of installation shall be between 8% and 13% in relation to oven-dry weight.

PLYWOOD

- A. Plywood shall be AWI premium grade with lumber or veneer core. Particleboard cores are not acceptable.
- B. Plywood for painted telephone/data equipment boards shall have A-B grade birch paint-grade veneer. Wood edge where exposed to view and wood edge all sides of adjustable shelving.
- C. Plywood for wall paneling, stained cabinets and shelving shall have premium solid piece white oak veneer, grade 1. Wood edge where exposed to view and wood edge all sides of adjustable shelving.

PLASTIC LAMINATE

- A. High-pressure decorative laminate complying with NEMA LD3, and the following requirements:
 - 1. Exterior Color Selection Available:
 - a. Architect will attempt to select colors from the plastic laminate selections preferred by the subcontractor; however, if the full range of colors, patterns, and finishes do not prove to be an entirely satisfactory match to the laminates indicated in the drawings the subcontractor shall provide the laminates exactly as specified in the drawings.
 - 2. Laminate grades:
 - a. Exposed doors, finished end panels, and other vertical surfaces; GP28 (0.028 inch thick nominal)
 - b. Horizontal surfaces other than top: GP28 (0.028 inch thick nominal)
 - c. Cabinet Liner: CL20 (0.020 inch nominal), white.
 - d. Work Surfaces and Countertops: GP50 (0.050 inch thick nominal) with BK20 (0.20 inch thick) backer sheet.
 - e. Backsplash: PH42 (0.042 inch thick nominal) with nominally balanced backer sheet.
 - 3. Adhesive: PVA water resistant adhesive. Contact adhesives not permitted.
 - 4. Pressure Fused Laminate:
 - a. NEMA LD3 VGL, and NEMA LD3 CLS, Melamine resin impregnated, 120 gram PSM minimum, thermofused to core under pressure.
 - b. Color:

- 1) Closed interiors, underside of wall cabinets: White.
- 2) Exposed and Semi-exposed open cabinets: Match exterior.
- c. Provide balanced construction with same thermofused melamine. Unsurfaced coreboard or simple backers not allowed.

CABINETS & SHELVING

A. The following definitions shall apply to cabinetwork:

1. Exposed; surfaces visible when doors and drawers are closed. Bottoms of cases and shelves more than 2'-0" above the floor and the back of hinged doors.
2. Semi-exposed; surfaces that become visible when drawers and doors are opened. Tops of cases and shelves more than 6'-0" above the floor and bottoms of cases and shelves less than 2'-0" above the floor.
3. Concealed; surfaces permanently hidden after installation such as backs or sides of cabinets against walls.

B. The following thicknesses of materials shall be used for cabinet construction and shelving unless noted differently on the plans:

1. Cabinet bottoms, ends and divisions shall be 3/4" thick.
2. Face plates shall be equal to door thickness with 3/4" minimum.
3. Cabinet backs and drawer bottoms shall be 1/4" thick plywood (1/2" plywood for file drawer bottoms). Drawers over 24" wide require center bottom support. Reinforce backs with strips or braces to limit area to 12 square feet.
4. Drawer fronts shall be 3/4" thick.
5. Drawer backs and sides shall be 1/2" thick.
6. Shelves shall be 3/4" thick up to 41" wide.
7. Install 3/4"x1-1/2" thick edge on front of 3/4" shelves 42" wide and over.
8. Doors shall be 3/4" thick.
9. Doors shall be 3/4" thick with perimeter moulding when detailed on drawings.

C. Cabinet construction shall be a modified half or partial overlay style with 1-1/2" of cabinet face stiles and rails typically showing between doors and drawers faces.

HARDWARE

A. The following cabinet hardware shall be provided.

1. Hinges shall be Salice, 120 degree, casework hinge, or equal, and required baseplates for half or partial overlay construction. Provide blocking behind face stiles at hinge locations. Provide number of hinges as recommended by manufacturer for particular door size and weight.
2. Door and drawer pulls shall be Stanley 4477AL-4", "Ribbon Pulls" or equal.
3. Standard drawer slides shall be KV 8400 series, 100 lb. rated, full extension, or equal.
4. File drawer slides shall be KV 8500 series, 150 lb. rated, full extension, or equal.
5. File drawers shall have KV 476F ZC letter-size file followers with KV 476TZC track, or equal. Provide 1/2" thick plywood drawer bottoms at file drawers and recess follower track in 2-1/4" wide x 1/4" deep slot.
6. Adjustable cabinet shelving standards shall be KV 255BRN with KV 256WAL supports, or equal.

7. Adjustable wall mounted shelving standards shall be KV 87ANO with KV 187ANO heavy duty brackets, or equal. Provide wood blocking in walls at standard locations.
8. Cabinet door and drawer locks, when shown on plans, shall be National C8053-14 cam locks, or equal, keyed alike in groups as directed by Owner.

FABRICATION

- A. Fabricate architectural woodwork in strict accordance with AWI Standard Details for Grade specified, shop assemble in the largest possible sections and deliver to site.
- B. Provide that work that cannot be shop assembled be given trial fit at the shop to ensure proper and expeditious field assembly. Join shop assemblies with mortise and tenon and dowels and glued blocks where practical. Mortises and tenons shall be of such size as will provide maximum strength in assembled joint. Provide blind tenons where exposed in finished work.
- C. When necessary to cut and fit on site, provide material with ample allowance for cutting; provide trim for scribing and site cutting.
- D. Apply plastic laminate finish in full, uninterrupted sheets consistent with manufactured sizes; corners and joints hairline; slightly eased edges.
- E. Mechanically fasten backsplash to countertops with concealed steel brackets at 16" on center.
- F. Apply laminate balancing sheet to reverse side of surface finished with plastic laminate in accordance with AWI Standard.
- G. Shop assemble architectural woodwork items for delivery to site in sizes easily handled and to ensure passage through building openings.

SITE CONDITIONS

- A. Deliver architectural woodwork products only when site environmental conditions are adequate to receive such products.
- B. Store products in ventilated areas with constant temperatures between 60 degrees F and 80 degrees F and relative humidity between 25 and 55 percent.
- C. Maintain temperature and humidity in installation area as required to maintain content of installed woodwork within a 1.0 percent tolerance of the optimum moisture content from the date of installation through the remainder of the construction period.

INSTALLATION – GENERAL

- A. Install woodwork plumb, level, true and straight with no distortions. Shim as required using concealed shims.
- B. Scribe and cut woodwork to fit adjoining work and refinish cut surfaces. Repair damaged finish at cut ends.
- C. Install to a tolerance of 1/8" in 8'-0" of plumb and level (including tops). Variations in flushness of adjoining surfaces are unacceptable.

- D. Anchor woodwork to built-in blocking or attach directly to substrates.
- E. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing.
- F. Leave surfaces clean and true with exposed wood sanded parallel with grain, free of discernable marks, dusted and ready for final finish.
- G. Countersink semi-concealed anchorage devices used to wall-mount components and conceal with solid plugs of species to match surrounding wood. Place flush with surrounding surfaces.

INSTALLATION – CABINETS

- A. Install countertops no more than 1/8" in 8'-0" of sag, bow or other variation from a straight line.
- B. Carefully scribe cabinetwork which is against other building materials leaving gaps of 1/32" maximum. Do not use overlay trim for this purpose.
- C. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and other fixtures and fittings. Verify locations of cutouts from on-site dimensions. Make cutouts for field penetration only after Architect's approval. Prime paint or seal contact surfaces of cutouts.
- D. Anchor tops secure to base units and other support systems.

ADJUSTMENT & CLEANING

- A. Repair damaged and defective woodwork to eliminate functional and visual defects.
- B. Where repairs are not acceptable to Architect, replace woodwork. Adjust joinery for uniform appearance.
- C. Clean woodwork on exposed and semi-exposed surfaces.
- D. Touch up damaged and soiled finishes and adjacent areas.

MATERIAL LOCATIONS

- A. Stained, painted or laminated finished components are clearly noted on the drawings.

END OF SECTION 06 20 00

SECTION 06 61 19 – QUARTZ SURFACE FABRICATIONS

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

PART 1 — GENERAL

RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including general and supplementary conditions and Division 1 Specification Sections, apply to this Section.

SUMMARY

- A. This Section includes the following horizontal and trim solid surface product types:

1. Composition quartz surfaces

- B. Related Sections include the following:

1. Division 5 Section “Metal Fabrications” for Blocking.
2. Division 6 Section “Rough Carpentry” for Blocking.
3. Division 7 Section “Joint Sealants.”

REFERENCES

- A. ASTM C920-05: Standard Specification for Elastomeric Joint Sealants
- B. [ASTM E84-05e1: Standard Test Method for Surface Burning Characteristics of Building Materials]
- C. [NFPA 255-2006: Standard Method of Test of Surface Burning Characteristics of Building Materials]

SUBMITTALS

- A. Product data:
1. For each type of product indicated.
- B. Shop drawings:
1. Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices and other components.
 - a. Show full-size details, edge details, thermoforming requirements, attachments, etc.
 - b. Show locations and sizes of furring, blocking, including concealed blocking and reinforcement specified in other Sections.
 - c. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers, waste receptacle and other items installed in solid surface.
- C. Samples:
1. For each type of product indicated.
 - a. Submit minimum 4-inch by 4-inch sample in specified gloss.

- b. Cut sample and seam together for representation of inconspicuous seam.
- c. Indicate full range of color and pattern variation.

2. Approved samples will be retained as a standard for work.

D. Product data:

- 1. Indicate product description, fabrication information and compliance with specified performance requirements.

E. Fabricator/installer qualifications:

- 1. Provide copy of certification number.

F. Manufacturer certificates:

- 1. Signed by manufacturers certifying that they comply with requirements.

G. Maintenance data:

- 1. Submit manufacturer's care and maintenance data, including repair and cleaning instructions.
- 2. Include in project closeout documents.

QUALITY ASSURANCE

A. Fabricator/Installer Qualifications: minimum three 3 years experience in fabricating and installing composition quartz surface materials, or a distributor's certification comprised of content.

B. Manufacturer's Certification: current ISO 9001 and 14001certificates.

DELIVERY, STORAGE AND HANDLING

A. Deliver no components to project site until areas are ready for installation.

B. Store components indoors prior to installation.

C. Handle materials to prevent damage to finished surfaces.

- 1. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

WARRANTY

A. Provide manufacturer's warranty against defects in materials.

- 1. Warranty shall provide material and labor to repair or replace defective materials.

B. Manufacturer's warranty period:

- 1. Ten years from date of substantial completion.

PART 2 — PRODUCTS

MANUFACTURERS

A. Manufacturers:

- 1. Subject to compliance with requirements, provide products by one of the following:
 - a. Wilsonart Quartz, 2501 Wilsonart Drive, Temple, TX 76503 (basis of design).

b. Cambria Quartz (basis of design)

MATERIALS

- A. Composition Quartz Sheet 1" (3cm) thick, comprised of silicon dioxide quartz chips set in a proprietary matrix, and meeting the following criteria.
1. Flammability: [Class A when tested to NFPA 255][Class A when tested to ASTM E84].
 2. Hardness (Mohs Scale): 7
 3. Density (KSF 2530): 2.465 g/cm²
 4. Stain Resistance (ANSI Z124.6.5.2): Pass
 5. Tensile Strength (ASTM D638): 17.8 MPa
 6. Compressive Strength (ASTM C170): 203 MPa wet, 209 MPa dry
 7. Finish: as indicated on drawings
- B. Brackets and Supports: cold-formed steel, galvanized finish; pre-drilled for fasteners, profiles and sizes as noted on shop drawings.

ACCESSORIES

- A. Joint adhesive:
1. Manufacturer's standard one- or two-part adhesive kit to create inconspicuous, nonporous joints.
 2. Adhesive for Bonding Quartz to Other Materials: one-component silicone, to ASTM C920.
- B. Sealant:
1. Manufacturer's standard mildew-resistant, FDA-compliant, NSF 51-compliant (food zone — any type), UL-listed silicone sealant in colors matching components.

FACTORY FABRICATION

- A. Shop assembly
1. Fabricate components to greatest extent practical to sizes and shapes indicated, in accordance with approved shop drawings and manufacturer's printed instructions and technical bulletins.
 2. Form joints between components using manufacturer's standard joint adhesive without conspicuous joints.
 - a. Reinforce with strip of solid polymer material, 2" wide.
 3. Provide factory cutouts for plumbing fittings and bath accessories as indicated on the drawings.
 4. Rout and finish component edges with clean, sharp returns.
 - a. Rout cutouts, radii and contours to template.
 - b. Smooth edges.
 - c. Repair or reject defective and inaccurate work.

PART 3 — EXECUTION

EXAMINATION

- A. Examine substrates and conditions, with fabricator present for compliance with requirements for installation tolerances and other conditions affecting performance of work.

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

INSTALLATION

- A. Install components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved shop drawings and product data.
1. Provide product in the largest pieces available.
 2. Form field joints using manufacturer's recommended adhesive, with joints inconspicuous in finished work.
 - a. Exposed joints/seams shall not be allowed.
 3. Reinforce field joints with solid surface strips extending a minimum of 1 inch on either side of the seam with the strip being the same thickness as the top.
 4. Cut and finish component edges with clean, sharp returns.
 5. Rout radii and contours to template.
 6. Anchor securely to base cabinets or other supports.
 7. Align adjacent countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop.
 8. Carefully dress joints smooth, remove surface scratches and clean entire surface.
 9. Install countertops with no more than 1/8-inch (3 mm) sag, bow or other variation from a straight line.
- B. Backsplashes and applied sidesplashes:
1. Install applied backsplashes using manufacturer's standard color-matched silicone sealant.
 2. Adhere applied backsplashes to countertops using manufacturer's standard color-matched silicone sealant.

REPAIR

A. Repair or replace damaged work which cannot be repaired to architect's satisfaction.

CLEANING AND PROTECTION

- A. Keep components clean during installation.
- B. Remove adhesives, sealants and other stains.

END OF SECTION 06 61 19

SECTION 07 19 16 – WATER REPELLENT

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

SUMMARY

- A. Penetrating water repellent applied to vertical surfaces of exterior Limestone Veneer.
- B. Related Sections
 - 1. Section 04 20 00 – Unit Masonry.
 - 2. Section 07 92 00 – Joint Sealants.

REFERENCES

- A. ASTM International:
 - 1. ASTM C67 – Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
 - 2. ASTM D1653 - Standard Test Method for Water Vapor Transmission of Organic Coating Films.
 - 3. ASTM D2369 Standard Test Method for Volatile Content of Coatings.
 - 4. ASTM D3278 Standard Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus.
 - 5. ASTM E514 Standard Test Method for Water Penetration and Leakage Through Masonry.
 - 6. ASTM G154 - Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials.

DESCRIPTION

- A. Clear-drying, water-based silicone emulsion for weatherproofing concrete block and other porous masonry materials and protecting them from graffiti attacks without altering the natural appearance.

SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Provide details of product description, tests performed, limitations to coating, cautionary procedures required during application, and chemical properties including percentage of solids.
- C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.
- D. Manufacturer's Certificate: Certify that product meets or exceeds specified requirements.

TEST AREA

- A. Test a minimum 4 ft. by 4 ft. area on each type of masonry. Use the manufacturer's application instructions. Let protective treatment test area cure before inspection. Keep test panels available for comparison throughout the protective treatment project.

QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this Section with minimum 5 years documented experience.
- B. Applicator: Company specializing in performing the Work of this Section with minimum 3 years documented experience approved by manufacturer.

ENVIRONMENTAL REQUIREMENTS

- A. Do not apply coating when surface temperature is lower than 20 degrees F or higher than 100 degrees F.
- B. Do not apply if rain is expected within two hours following application, or if high winds or other conditions prevent proper application. If rain has preceded the application, the surface should be allowed to dry at least 24 hours.

QUALITY ASSURANCE

- A. Manufacturer's Representative shall be available throughout the project to ensure that the materials are applied properly and are performing in according to Specifications requirements.
- B. Manufacturer's Representative shall conduct a post-application inspection and report any deficiencies noted.

MANUFACTURER

- A. ProSoCo Inc., 3741 Greenway Circle, Lawrence, KS 66046, (800) 255-4255, www.prosoco.com.
- B. Substitutions: Under provisions of Section 01 25 00.

MATERIALS

- A. Sure Klean Weather Seal Natural Stone Treatment.
 - 1. Modified siloxane water repellent developed for limestone, marble and most other traditional masonry surfaces.
 - 2. Typical Technical Data:
 - a. Form: Clear, slightly yellow liquid, mild petroleum odor
 - b. Specific Gravity: 0.805
 - c. pH: not applicable
 - d. Weight/Gallon: 6.70 pounds
 - e. Active Content: 11 percent
 - f. Total Solids: 9 percent ASTM D 2369
 - g. VOC Content: >713 grams per Liter.
 - h. Flash Point: 118 degrees F (48 degrees C) ASTM D 3278
 - i. Freeze Point: less than -22 degrees F (less than -30 degrees C)
 - j. Shelf Life: 2 years in tightly sealed, unopened container

EXAMINATION

- A. Verify joint sealants are installed and cured.

- B. Verify surfaces to be coated are dry, clean, and free of efflorescence, oil, or other matter detrimental to application of coating.

PREPARATION

- A. Delay Work until substrate is cured a minimum of 60 days.
- B. Remove loose particles and foreign matter.
- C. Remove oil or foreign substance with a chemical solvent that will not affect coating.
- D. Scrub and rinse surfaces with water and let dry.

APPLICATION

- A. Apply as packaged. Do not dilute or alter.
 - 1. For best results, apply "wet on wet" to a thoroughly dry surface. Saturate from the bottom up using enough material to create a 6-8 inch rundown below the spray contact point. Brush out heavy runs and drips that do not penetrate after a few minutes.
 - 2. Let the first application penetrate the surface.
 - 3. Within 5 minutes, reapply in the same saturating manner. Less material will be required on the second application.

PROTECTION

- A. Protect adjacent surfaces not scheduled to receive coating. May damage glass or be difficult to remove. Always protect.
- B. Protect landscaping, property and vehicles.
- C. If applied to non-masonry surfaces, remove immediately by a method instructed by manufacturers.

END OF SECTION 07 19 16

SECTION 07 21 00 – THERMAL AND ACOUSTICAL INSULATION

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

SCOPE

- A. Install rigid cavity wall insulation on exterior sheathing prior to installation of masonry veneer.
- B. Install batt insulation used for thermal and sound insulation in stud walls and where shown on drawings or required.
- C. Install thermal batt insulation between joists under steel roof deck and crevices in exterior wall and roof construction.
- D. Install batt insulation used for sound insulation above ceiling where shown on drawings.

SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's literature on each insulation type specified.
 - 2. Manufacturer's installation instructions for each insulation type specified.
- B. Samples: Six (6) inch x six (6) inch piece of rigid insulation for Architect's approval.
- C. Certifications:
 - 1. Manufacturer's certification of compatibility of rigid insulation with dampproofing mastic.
 - 2. Manufacturer's affidavit that materials used in Project contain no asbestos.

PERFORMANCE

- A. Foil-Faced, Polyisocyanurate Board Insulation: ASTM C1289, Type I, Class 1, with maximum flame-spread and smoke-developed indexes of ≤ 25 and ≤ 450 , per ASTM E84.
 - 1. Minimum Compressive Strength ≥ 25 psi when tested per ASTM D1621
 - 2. Minimum Tensile Strength ≥ 1000 when tested per ASTM C209
 - 3. Minimum Flexural Strength ≥ 40 psi when tested per ASTM C203
 - 4. Water Vapor Transmission ≤ 0.05 perms per inch when tested per ASTM E96
 - 5. Water Absorption Maximum $\leq 1\%$ by volume when tested per ASTM C209
 - 6. Dimensional Stability, Maximum $\leq 0.05\%$ length and width, and $\leq 3.5\%$ thickness when tested per ASTM D2126
 - 7. R-value per thickness: 1.5"=R-10

PRODUCTS

RIGID INSULATION

- A. Cavity wall insulation shall be 1.5" thick Dow Thermax Cavity Wall Insulation (Basis of Design) at metal stud backup, with reinforced polyisocyanurate foam core and reinforced foil facing. Provide in 24" wide (verify to match vertical spacing of masonry wall ties) and 96" long units.
- B. Other Manufacturers subject to compliance with requirements:
 - 1. Firestone Building Products; Enverge CI Glass Exterior Wall Insulation.
 - 2. Atlas Roofing, AtlasWall EnergyShield Pro.

C. Adhesives and Fasteners:

1. Provide Mechanical fasteners and adhesive suitable for metal stud backup shall be as recommended or approved by insulation manufacturer.

D. Joint Tape:

1. Provide matching foil faced joint tape as manufactured by Dow to use with this product. Provide enough additional tape as may be needed to cover and repair nicks and cuts in insulation's foil facing which might occur during installation of masonry veneer.

BATT INSULATION

A. Interior wall thermal/acoustical insulation shall be 3 1/2" thick, R-11 unfaced fiberglass as manufactured by Owens Corning Fiberglass Corporation (Basis of Design).

B. Other Manufacturers subject to compliance with requirements:

1. CetainTeed Corporation.
2. Knauf Insulation.

C. Exterior Insulation Batt shall be fiberglass or spun mineral fiber and resinous binders formed into flexible blankets or batts.

1. Facing: Unfaced
2. Comply with ASTM C665, Type III, Class A
3. Batt Size: 16 inches wide x 96 inches long x 6 inches thick
4. Thermal Resistance Value: R value of 15 at exterior wall locations
5. Pressure Sensitive Tape: Permanent Type as recommended by insulation manufacturer.
6. Tie Wire: Minimum 16 gauge aluminum or other non-ferrous material.

EXAMINATION

A. Consult with tradesmen whose work precedes and follows insulation installation to insure that their preparatory and finish work coordinates in an orderly fashion with work under this section.

B. Clean substrates of substances harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

C. Do not install any insulation until the building has been made substantially water and weathertight.

INSTALLATION

A. Install insulation boards between horizontal rows of masonry wall ties at 24" o.c. (verify to match vertical spacing of brick wall ties) using a combination of adhesive and mechanical fasteners as recommended or approved by insulation manufacturer. Stagger vertical joints. Once insulation boards are securely attached to metal stud backup, apply manufacturer provided foil faced tape over all joints. Cut tape long and slit ends to lap over and around metal wall ties. Also place tape around all pipes, conduits, anchor bolts or other items penetrating insulation boards. Cover any screw heads or other mechanical fastener heads with tape as well.

B. Install in as large of pieces as possible to minimize joints. Size to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths.

- C. Use manufacturer's acceptable 4" wide aluminum foil tape to seal all:
 - 1. Board-to-board joints.
 - 2. Fastener heads
- D. Use manufacturer's acceptable 6" wide aluminum foil tape to seal all:
 - 1. End joints.
 - 2. Thru-wall penetrations such as windows, doors or pipe penetrations.
 - 3. Joints between exterior wall insulation and adjacent air barrier materials.
- E. Protect all insulation work during installation and until work is covered. Insulation which becomes compressed, displaced or otherwise damaged shall be removed and replaced with new undamaged material.
- F. Notify Architect upon completion of work or portions of the work to allow inspection prior to enclosing or covering.
- G. Install Batt insulation with joints butting tightly. Cut to fit around obstructions.
- H. Attach to channel frame work or substrate with wire spring clips; between framing members by friction fit, and with supplementary tape or tie wire when applied in heights over 8 feet. Fit around obstructions.
- I. Support for batt insulation, friction fit where the insulation stud cavity is not enclosed on both sides.
 - 1. Insert wires through fiberglass insulation extending from stud to stud. Wires may be installed continuously through the punch outs of the steel stud framing. Or, heavy gauge wire may be cut slightly larger than each stud space and wedged into place between studs. Where batt insulation thickness is less than the depth of the stud cavity, position wires to hold the batt against the sheathing on the opposite site of the cavity.
 - 2. Use of punch metal straps attached to the face of the framing. The punched pronged tabs are bent 90 degrees pointing into the stud cavity and are pushed into the insulation after installation.

PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

CLEAN UP

- A. Remove all scrap materials and packaging and properly dispose of offsite.

END OF SECTION 07 21 00

SECTION 07 26 16 – BELOW-GRADE VAPOR RETARDERS

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

PART 1 – GENERAL

SECTION INCLUDES

- A. Surface preparation.
- B. Application of an underslab vapor retarder.

REFERENCES

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM E1745 Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
 - 2. ASTM E154 Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs.
 - 3. ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials.
 - 4. ASTM E1643 Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
 - 5. ASTM F1249-01 Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor.
- B. American Concrete Institute (ACI)
 - 1. ACI 302.1R-96 Vapor Barrier Component (plastic membrane) is not less than 10 mils thick.

SUBMITTALS

- A. Comply with Division 1 – Submittal Procedures.
- B. Submit manufacturer's product data and application instructions.

DELIVERY, STORAGE & HANDLING

- A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Store materials in a clean dry area in accordance with manufacturer's instructions.
- C. Stack membrane on smooth ground or wood platform to eliminate warping.
- D. Protect materials during handling and application to prevent damage or contamination.

ENVIRONMENTAL REQUIREMENTS

- A. Product not intended for uses subject to abuse or permanent exposure to the elements.

B. Do not apply on frozen ground.

PART 2 – PRODUCTS

MANUFACTURERS

- A. Stego Industries, LLC (Basis of Design)
27442 Calle Arroyo, Suite A
San Juan Capistrano, CA 92675
(877)-464-7834
Texas, Louisiana, Oklahoma
Regional Office Contact:
(281) 367-0040
- B. W.R. Meadows, Inc.
P. O. Box 338
Hampshire, Illinois 60140-0338
(800) 342-5976. (847) 683-4500
Fax (847) 683-4544
Web Site www.wrmeadows.com
- C. Poly-America LP
2000 West Marshall Drive,
Grand Prairie, TX 75051
(800)-527-3322 ext 7437

MATERIALS

A. Plastic Vapor Retarder

1. Performance Based Specification: Vapor Retarder membrane must meet or exceed all requirements of ASTM E1745 Classes A, B, and C.
 - a. Minimum Permeance ASTM E96: 0.018 Perms
 - b. Water Vapor Transmission Rate ASTM F1249 calibrated to ASTM E96 (water method): 0.007 grains/ft²/hr
 - c. Resistance to Organisms and Substrates in Contact with Soil ASTM E154, Section 13: 0.027 Perms
 - d. Tensile Strength ASTM E154, Section 9: 84 LBS. Force/Inch
 - e. Puncture Resistance ASTM D1709, Method B: 4,335 Grams
 - f. Water Vapor Retarder ASTM E1745: Meets or exceeds Classes A, B, and C
 - g. Thickness of Retarder (plastic) ACI 302.1R-96: Not less than 10 mils
2. Proprietary Based Specification
 - a. “Stego-Wrap” 10 mil Class A by Stego Industries.
 - b. Perminator™ 10 mil by W.R. Meadows.
 - c. Husky Yellow Guard 10 mil by Class A by Poly-America.

ACCESORIES

A. Seam Tape

1. High Density Polyethylene Tape with pressure sensitive adhesive. Minimum width 6 inches.
 - a. Stego Crete Claw 6" tape

B. Pipe Boots and Penetrations

1. Construct pipe boots from vapor barrier material and pressure sensitive tape per manufacturer's instructions.
 - a. Stego Mastic

C. Perimeter edge seal

1. High Density Polyethylene Tape with pressure sensitive adhesive. Minimum width 6 inches.
 - a. Stego Crete Claw 6" tape

PART 3 – EXECUTION

EXAMINATION

- A. Examine surfaces to receive membrane. Notify Architect if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected.

SURFACE PREPARATION

- A. Prepare surfaces in accordance with manufacturer's instructions.

APPLICATION

- A. Installation shall be in accordance with manufacturer's instructions and ASTM E 1643-98.
- B. Unroll vapor barrier with the longest dimension parallel with the direction of the pour.
- C. Lap vapor barrier over footings and seal to foundation walls.
- D. Overlap joints 6 inches and seal with manufacturer's tape.
- E. Apply Crete Claw tape between seams at 42" o.c. max parallel to seams.
- F. Seal all penetrations (including pipes) with manufacturer's pipe boot.
- G. No penetration of the vapor barrier is allowed except for reinforcing steel and permanent utilities.
- H. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 6 inches and taping all four sides with tape.

END OF SECTION 07 26 16

SECTION 07 27 20 – FLUID-APPLIED AIR BARRIER

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

SCOPE

- A. Install one-component vapor permeable, liquid applied elastic air and water barrier.
- B. Materials and installation to bridge and seal the following air leakage pathways and gaps:
 - 1. Connections of the walls to the roof air barrier.
 - 2. Connections of the walls to the foundations.
 - 3. Expansion joints.
 - 4. Openings and penetrations of window frames, store fronts, and curtain walls.
 - 5. Barrier precast concrete and other envelope assembly.
 - 6. Door frames.
 - 7. Piping, conduit, duct and similar penetrations.
 - 8. Masonry ties, screws, bolts and similar penetrations.
 - 9. All other air leakage pathways in the building envelope
 - 10. Sealing flashing to wall surface.

PERFORMANCE REFERENCES

- A. Air Barrier Association of America:
 - 1. ABAA List of Evaluated Assemblies.
- B. American Association of Textile Chemists and Colorists:
 - 1. AATCC 127 – Water Resistance: Hydrostatic Pressure Test.
- C. ASTM International:
 - 1. ASTM D1970 – Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
 - 2. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 3. ASTM E96 – Standard Test Methods for Water Vapor Transmission of Materials.
 - 4. 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.
 - 5. ASTM E331 – Standard Test Method for Structural Performance of Exterior Windows, Curtains, and Doors by Uniform Static Air Pressure Difference.
 - 6. ASTM E2178 – Standard Test Method for Determining the Air Permeability of Building Materials.
 - 7. ASTM E2357 – Standard Test Method for Determining Air Leakage of Air Barrier Assembly.
- D. ICC Evaluation Service:
 - 1. ICC-ES AC212 – Water Resistive Coatings Used as Water Resistive Barrier over Exterior Sheathing.
- E. Codes
 - 1. 2021 International Building Codes

PERFORMANCE REQUIREMENTS

- A. Provide an air barrier system constructed to perform as a continuous elastic air barrier, and as a liquid water drainage plane flashed to discharge to the exterior any incidental condensation or water penetration. Membrane shall accommodate movements of building materials by providing expansion and control joints as required, with accessory air seal materials at such locations, changes in substrate and perimeter conditions.
1. The air barrier shall have the following characteristics:
 - a. It must be continuous, with all joints made air-tight.
 - b. It shall be capable of withstanding positive and negative combined design wind, fan and stack pressures on the envelope without damage or displacement, and shall transfer the load to the structure. It shall not displace adjacent materials under full load. The air barrier shall be joined in an airtight and flexible manner to the air barrier material of adjacent assembly, allowing for the relative movement of assembly due to thermal and moisture variations and creep. Connection shall be made between the following:
 - 1) Foundation and walls
 - 2) Walls and windows or doors
 - 3) Different wall assembly
 - 4) Wall and roof
 - 5) Wall and roof over unconditioned space
 - 6) Walls, floor and roof across construction, control and expansion joints.
 - 7) Walls, floors and roof to utility, pipe and duct penetrations.
 - 8) Flashing to wall surface.
 2. All penetrations of the air barrier and paths of air infiltration/exfiltration shall be made air-tight.
 3. Air Permeability: Maximum 0.04 cfm/sq.ft. @ 10.5 per ASTM E283.
 4. Air Permeability: @ delta P of 0.3 inches water..0.002 CFM/ft² per ASTM E2178.
 5. ASTM E2357, Full Scale Wall Testing of Air Barrier System.
 6. ASTM E96 Water Vapor Permeance: 10-20 Perms per Procedure B.
 7. ASTM E331, 10psf for 2 hours.
 8. Elongation: Minimum 50% per ASTM D412.
 9. AATC 127 Water Resistance –Pass
 10. ASTM D1970 Self Sealability – Pass
 11. ICC-ES AC212, Freeze, Thaw, Crack Bridging – Pass.
 12. Fire Testing: Air Barrier as a component of a wall assembly, shall have passed a NFPA 285 complete wall fire test.
 13. ASTM E84 Class A Fire Resistant.
 14. Listed as an evaluated assembly by the ABAA at www.airbarrier.org.

SUBMITTALS

- A. Submit manufacturer's independent Laboratory Report fro the Air Barrier Assembly testing on ASTM E 2357 tested on a steel stud frame wall.
- B. Submit documentation certifying that the air barrier system has been tested independently, indicating compliance with the performance requirements of the Air Barrier Association of America.
- C. Submit copies of manufacturer's literature for the system, membrane, primers, sealants, adhesives and associated auxiliary materials shall be included as parts of the system that is listed by the Air Barrier Association of America.

- D. Submit manufacturer's complete set of standard details for air barrier/vapor retarders. The manufacturer shall review the contract drawings and not any modifications required to make the system air and water tight.

QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Provide primary products, including each component of the air barrier membrane system, which has been commercially available for a minimum of 3 years.
- B. Submit document stating that the applicator of the primary air barrier membrane specified in this section is recognized by the manufacturer as suitable for the execution of the Work.
- C. Perform Work in accordance with the printed requirements of the air barrier manufacturer and this specification.
- D. Maintain a copy of manufacturer instructions on site.
- E. Allow access to Work site by the air barrier membrane manufacturer's representative.

PRE-INSTALLATION CONFERENCE

- A. Convene four weeks prior to commencing work of this section. Attendance by the manufacturer's representative along with the installer.
- B. Do not start installation of Air Barrier Membrane and Flashing prior to the Pre-Installation Meeting.

PRODUCTS

MEMBRANE

- A. Liquid Air Barrier: One component elastomeric membrane, spray, trowel or brush applied, having the following characteristics and have passed all evaluations by the Air Barrier Association of America (ABAA) and be listed on their web site as having passed all the evaluations.
1. Air Barrier Material permeability test:
 - a. Air Leakage per ASTM E2178, dry film, delta P of 0.3 inches of water, $0.002 \pm 10\%$.
 2. Air Barrier System Test on Full Scale Wall Assembly, ASTM E2357
 - a. System Air Leakage, $0.0008 \text{ CFM/ft}^2 \pm 10\%$
 - b. Penetrations Check, Must pass ASTM E2357 requirements
 3. Water Vapor permeance: (704 ng/Pa.m².s) 10 to 20 perms, ASTM E96 Method B.
 - a. Note: Material specified is Vapor Permeable.
 4. Elongations (ASTM D412: > 50%)
 5. Low temperature flexibility and crack bridging: Pas – ICC-ES AC212
 6. ASTM D1970, Self Sealability – Pass
 7. AATCC 127 Water Resistance – Pass
 8. ASTM E84, Class A Fire Resistant
 9. Recycle content >20%
- B. Acceptable Manufacturers:
1. STS Coating, Wall Guardian, 830-995-5177, www.wallguardian.com.
 - a. FW-100A, a non-asphaltic product.
 2. Carlisle Coatings & Waterproofing, 800-527-7092, www.carlisleccw.com

- a. Barritech VP, a non-asphaltic product
3. Sika-Sarnafil, 201-933-8800, www.sikausa.com
 - a. Sikaguard 530, a non-asphaltic product.
- C. Transition Membrane, Self-Adhering: Polymer-based, sheet membrane complete with polyester facing, and having the following physical properties:
 1. Thickness: 35 mils (0.5 mm) min.
 2. Vapor permeance: <0.1
 3. Low temperature flexibility: -20 F to CGSB 37-GP-56M;
 4. Elongation: >90% to ASTM D412-modified
 5. ASTM E331, 10psf for 2 hours
 - a. Acceptable Material:
 - 1) UT-40 by STS Coatings for use with the FW-100 system.
 - 2) Others as recommended by approved manufacturer.
- D. Contractor Qualifications:
 1. Contractor shall provide a manufacturer's letter stating that they have been trained and are approved to apply the manufacturer's air barrier.
 2. An ABAA Certified Contractor, specific certification for liquid applied and approved by letter from the manufacturer.

PRIMER

- A. Primer for self-adhering membranes: Synthetic polymer-based adhesive type, quick setting, having the following characteristics:
 1. Acceptable material: As manufactured and / or recommended by the Air Barrier System manufacturer. Note: Primer shall be compatible with specified exterior gypsum sheathing.
 2. Verify compatibility of self-adhering membranes with preservative treated materials specified in Section 6. Prime preservative treated materials as required using primer recommended by self-adhering membrane manufacturer or use the non-chemical thermally modified wood known as EcoPrem.

SEALANTS

- A. Sealants shall be compatible with air barrier assembly and shall be approved by the air barrier manufacturer.
- B. Products:
 1. STS Coatings LT-100 Liquid Tape for concealed applications only and Great Seal PE-150 for concealed and exposed applications.
- C. Primers: As recommended by manufacturer for surfaces to be sealed.
- D. Backer Rods: As recommended by sealant manufacturer.

EXAMINATION

- A. Verify that surfaces and conditions are ready to accept the Work of this section. Notify Architect in writing of any discrepancies. Commencement of the Work or any parts thereof shall mean acceptance of the prepared substrate.

PREPARATION

- A. All surfaces must be sound, dry, clean and free of oil, grease, dirt, excess mortar or other contaminants. Fill spalled areas in substrates to provide an even plane.
- B. Mortar joints in concrete block and form tie holes/voids in poured concrete shall be filled flush and smooth and allowed to be cured for a minimum of 24 hours.
- C. All joints between gypsum sheathing, roof board, masonry and concrete and other substrate joints up to 1/4" wide shall be treated.
 - 1. STS Coatings LT-100 Liquid Tape, www.stscoatings.com
 - 2. Others as recommended by approved manufacturer.
- D. All joints between gypsum sheathing, roof board, masonry and concrete and other substrate wider than 1/4" shall be sealed with:
 - 1. UT-40, overlapping each side of joint a minimum of 3 inches.
 - 2. Others as recommended by approved manufacturer.
- E. Install backer rod and sealant at the following joints:
 - 1. All expansion/control/erection joints between concrete wall panels.
 - 2. All expansion/control joints in concrete block back-up.
 - 3. All joints between concrete wall panels and concrete block back-up.

TRANSITION MEMBRANE (SELF-ADHERING TYPE ONLY)

- A. Primer:
 - 1. Apply primer for self-adhering membranes at rate recommended by manufacturer.
 - 2. Apply primer to all areas to receive transition sheet membrane as indicated in Drawings by roller or spray and allow minimum 30 minute open time. Primed surfaces not covered by transition membrane during the same working day must be re-primed.
- B. Membrane:
 - 1. Align and position self-adhering transition membrane, remove protective film and press firmly into place. Ensure minimum 2 inch overlap at all end and side laps unless otherwise noted.
 - 2. Tie-in to roofing system and at the interface of dissimilar materials as indicated on Drawings.
 - 3. Promptly roll all laps and membrane with a counter top roller to affect seal.
 - 4. Ensure all preparatory work is complete prior to applying liquid membrane.

PRIMARY AIR BARRIER

- A. Apply by spray or roller, a complete and continuous unbroken film at an ambient and substrate surface temperature of 40°F and rising with less than a 30% chance of rain in the next 18 hours and apply at the same rate as listed in the Air Barrier Association of America evaluation.
 - 1. Exterior Gypsum Sheathing, Plywood or OSB.
 - a. Wall Guardian FW-100A at a minimum of 2.5 gallons per 100ft² (40 ft²/gallon) (40 wet mils)
 - b. Others meeting stated ABAA approval coverage rates.
 - c. Spray around all projections, including masonry veneer anchors, ensuring a complete and continuous air seal.
 - 2. Concrete Masonry Unit (CMU) Concrete
 - a. Wall Guardian FW-100A at a minimum of 2.5 gallons per 100 ft² (40ft²/gallon) (equal to 40 wet mils on a smooth surface)

- b. Others meeting state ABAA approval coverage rates.
- c. Spray around all projections including masonry veneer anchors ensuring a complete and continuous air seal.

INSPECTION

- A. Notify Architect when sections of work are complete so as to allow for review prior to installing insulation. The manufacturer's representative shall be on site to review the installation.

PROTECTION

- A. Cover the liquid membrane as recommended by the manufacturer, within the following time frames. Contractor shall verify the number of calendar days with the air barrier manufacturer.
 - 1. Cover the Wall Guardian material within 180 calendar days after installation. The nature of this product is such that some surface weathering may become apparent during exposure.
- B. Prepare, treat and seal vertical and horizontal surfaces at terminations and penetrations through air barrier and at protrusions according to the air barrier manufacturer's written instructions.

SCHEDULE

- A. Install liquid membrane system over the entire surface of the exterior sheathing in the following area. Seal any masonry anchor penetrations air tight.
- B. Install liquid membrane system over the entire surface of the outer surface of the inner wythe of masonry. Seal any masonry anchor penetrations air tight.
- C. Install liquid membrane system over the entire surface of outer surface of concrete wall panels. Seal any masonry anchor penetrations air tight.
- D. Install liquid membrane system over the entire surface of the exterior gypsum sheathing and /or roof board in the following area:
 - 1. Parapets
 - 2. Behind all wall veneers and soffit panels
- E. Hollow Metal Door Frames: Seal door frame to wall surface with transition membrane.
- F. Wall and Roof Junction: Seal wall to roof with transition membrane.
- G. Seal joints in exterior sheathing with tape in the following areas:
 - 1. Walls
 - 2. Soffit Areas
- H. Seal the top of sheathing to the underside of the roof assembly with foam or LT-100.
- I. Openings: Seal around the perimeter of all openings with transition membrane.
- J. Perimeter wood nailers as wall openings: Cover all exposed surfaces of wood nailers with transition membrane. Extend membrane over sheathing, masonry and metal framing as shown.

- K. Aluminum window frames and nailing flanges. Seal the nailing flange to the wall surface with transition membrane.
- L. Aluminum window frames without nailing flanges: Seal frames to the wall surface with transition membrane.
- M. Aluminum storefront frames: Seal frames to the wall surface with transition membrane.

END OF SECTION 07 27 20

SECTION 07 41 13 – METAL ROOF PANELS

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

SCOPE

A. Section Includes:

1. Architectural standing-seam metal roof panels.
2. Metal roof accessories.
3. Roof insulation.
4. Miscellaneous metal framing.

REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM A653/A653M Standard Specification for Steel Sheets, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
2. ASTM A792/A792M Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy Coated by the Hot Dip Process.
3. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
4. ASTM D2247 Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
5. ASTM E1680 Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen.
6. ASTM E1646 Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
7. ASTM G90 Standard Practice for Performing Accelerated Outdoor Weathering of Non-Metallic Materials Using Concentrated Natural Sunlight.
8. ASTM D 2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.
9. ASTM D 4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films
10. ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials
11. ASTM E 1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.
12. ASTM E 2140 - Standard Test Method for Water Penetration of Metal Roof Panel Systems by Static Water Pressure Head.

B. Underwriters Laboratories (UL):

1. UL 263 - Fire Tests of Building Construction and Materials.
2. 580 - Tests for Uplift Resistance of Roof Assemblies.
3. UL 790 - Standard Test Methods for Fire Tests of Roof Coverings.
4. UL 2218 - Impact Resistance of Prepared Roof Covering Materials.

- C. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA); "Architectural Sheet Metal Manual"

ADMINISTRATIVE REQUIREMENTS

A. Pre-installation Meetings:

1. Schedule meeting to discuss roof project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements before start of work onsite. Comply with Division 1 (Project Meetings) Section.
2. Required attendees: Contractor, metal deck & roof installer, and any other subcontractors who have equipment penetrating the roof or work that requires roof access or traffic.

SYSTEM DESCRIPTION

A. Performance Requirements: Provide sheet metal roofing which has been manufactured, fabricated and installed to withstand structural and thermal movement, wind loading and weather exposure to maintain manufacturer's performance criteria without defects, damage, failure or infiltration of water.

1. Air infiltration: Maximum 0.06 cfm per lineal foot (0.33 m³/hr per linear meter) of seam at static pressure of 6.24 psf (3.0 kPa) when tested per ASTM E1680.
2. Water penetration:
 - a. No uncontrolled water penetration through the joints at a static pressure of 6.24 psf (3.0 kPa) when tested in accordance with ASTM E1646.
3. Fire rating: Class A
4. Uplift Tests:
 - a. UL 580 Class 90
 - b. FM 4471 2" only I-90
 - c. ASTM E 1592 2"
5. Miami Dade: 2" x 16" only
6. Class 4 Impact Resistance: UL 2218
7. Fire Resistance: UL 263
8. Florida State Approval
9. ICC-ES: ESL 1082

B. Finish Performance Requirements:

1. Two coat coil applied, baked on full strength (70% resin, PVF2) fluorocarbon coating consisting of a nominal 0.25 mil dry film thickness primer, and a nominal dry film thickness of 0.7 -0.8 mil color coat for a total 0.9 to 1.1 mil total system dry film thickness.
2. Color change and fade resistance: No cracking, peeling, blistering or loss of adhesion when tested in accordance with ASTM G23; color change, after removal of surface deposits such as dirt or chalk, maximum 5 NBS units.
3. Humidity resistance: No blistering, peeling or loss of adhesion after 1000 hours testing, in accordance with ASTM D2247.

SUBMITTALS

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

- B. Product Data: Submit manufacturer's product data for specified products.
- C. Shop Drawings: Submit shop drawings showing layout, profiles and product components, including anchorage, accessories, finish colors and textures.
1. Indicate layout of roofing panels and roof panel sizes, including custom-fabricated roofing panels if indicated; indicate each item of trim and accessories.
 2. Indicate in detailed drawings profile and gauge of interior and exterior sheets, and locations and types of fasteners; indicate locations, gauges, shapes and methods of attachment of roofing panels, trim and accessory items.
 3. Include Sealant location and denote those that are factory and field applied.
 4. Indicate products/materials required for construction activities and field worked conditions of this section not supplied by manufacturer of products of this section.
- E. Samples: Submit selection and verification samples for finishes, colors and textures.
1. Selection Samples: For each product requiring color selection, 2 sets of manufacturer's sample chips representing full range of colors and finishes available.
 2. Verification Samples: For each color and finish selected, 2 chips indicating match to selected color and finish.
- F. Warranties:
1. Substrate Warranty
 2. Finish Warranty
 3. Weather Tightness Warranty (if applicable)
- G. Quality Assurance Submittals: Submit the following:
1. Contractor Certificates: Contractor's certification that:
 - a. Manufacturer of products of this section meets specified qualifications.
 - b. Installer of products of this section meets specified qualifications.
 2. Manufacturer Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and physical requirements.
 3. Manufacturer's Instructions: Manufacturer's installation instructions.
 4. Manufacturer's Field Reports: Manufacturer's field reports if required.
- H. Closeout Submittals: Submit the following:
1. Warranty: Warranty documents specified herein.

QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Provider of "hands on" installer training at manufacturer or customer facility.
2. Minimum of ten years' experience in manufacturing metal roof systems.
3. Provider of product produced in a permanent factory environment with fixed roll-forming equipment and also possesses the capability to roll form continuous panels on jobsites with a factory technician for jobs with panel lengths in excess of 50'

B. Installer Qualifications:

1. At least five years' experience in the installation of structural standing seam metal roof panels.
2. Experience on at least five projects of similar size, type and complexity as this project that have been in service for a minimum of two years with satisfactory performance of the roof system.
3. Employer of workers for this project who are competent in techniques required by manufacturer for installation indicated and who shall be supervised at all times when material is being installed.
- C. Mock-Ups: Establish standards by which work will be judged. Coordinate below with Division 1 Quality Control (Mock-up Requirements) Section. Mock-Ups: Install at project site a job mock-up using acceptable products and manufacturer approved installation methods. Obtain Owner's and Architect's acceptance of finish color, texture and pattern and workmanship standard. Comply with Division 1 Quality Control (Mock-Up Requirements) Section.

DELIVERY, STORAGE & HANDLING

- A. General: Comply with Division 1 Product Requirements Sections.
 1. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact. Identify fabricated components with UL 90 label where appropriate.
- C. Delivery and Acceptance Requirements: Ensure all panels are received in good condition. In cases where damage is visible, note all paperwork; inform architect and project superintendent.
- D. Packing, Shipping, Handling and Unloading:
 1. Roofing panels to be crated to protect panels from shipping damage.
 2. Package trim and accessories in waterproof wrapping paper.
- E. Storage and Protection: Store materials protected from exposure to harmful conditions. Store material in dry, above-ground location.
 1. Stack prefinished material to prevent twisting, bending, abrasion, scratching and denting. Elevate one end of each skid to allow for moisture runoff.
 2. Store products of this section in manufacturer's unopened packaging until installation of products
 3. Maintain dry, heated storage area for products of this section until installation of products.
 4. Remove strippable plastic film before storage under high-heat conditions.
- D. Protect strippable protective covering on metal roof panels from exposure to sunlight and high humidity, except to extent necessary for period of metal roof panel installation.
- E. Protect foam-plastic insulation as follows:
 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
 2. Protect against ignition at all times. Do not deliver foam-plastic insulation materials to Project site before installation time.
 3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PROJECT CONDITIONS

- A. 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.
- B. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed in accordance with manufacturers' written instructions and warranty requirements.

COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
- B. Coordinate metal roof panels with rain drainage work, flashing, trim, and construction of substrate, parapets, walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

WARRANTY

- A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.
 - 1. Panel Material: Furnish manufacturers 25 year warranty covering the panel against rupture, structural failure, or perforation.
 - 2. Panel Coating: Furnish manufacturer's 40-year warranty covering cracking, checking, and peeling, and 30 year warranty covering fade and chalk on the Two coat coil applied, baked on full strength (70% resin, PVF2) fluorocarbon coating.
 - a. Manufacturer's warranty may exclude surface deterioration due to physical damage and corrosive environments.
- B. Special Warranty: Installer's standard form in which installer agrees to repair or replace panels that fail due to poor workmanship or faulty installation within the specified warranty period.
 - 1. Warranty Period: 1 year from date of Substantial Completion.

PRODUCTS

- A. Metal Roof Panels
- B. Manufacturer: McElroy Metal, Inc.
 - 1. Contact: 1500 Hamilton Rd., Bossier City, LA 71111; Telephone: (800) 950-6531; Fax: (318) 747-8099; E-mail: info@mcelroymetal.com; website: www.mcelroymetal.com.
 - 2. Proprietary Products: McElroy Metal Preformed Sheet Metal Roofing Panels.
- C. Substitutions:
 - 1. Basis of Design Product: Subject to compliance with requirements provide McElroy Metal Maxima

- D. Forming: Use continuous end rolling method. No end laps are permitted on panels without architect approval. It is the intent of the Architect to provide factory-manufactured panel systems or systems manufactured on-site by factory personnel only for this project.

MANUFACTURED UNITS

A. McElroy Metal Maxima Panels:

1. Profile: Vertical leg standing seam panel with male/female seam to be mechanically interlocked at jobsite with mechanical seamer specifically designed for Maxima profile.
2. Size: 2" high seam by 12" width (51 x 406 mm) Length as indicated on drawings.
3. Panel Surface: 2": Pencil Rib
4. Material: Galvalume steel sheet conforming to ASTM A792, AZ50 coating for bare; AZ50 coating for painted; [24; 22] gauge sheet thickness.
5. Panels should be factory formed for lengths below 50'. To avoid lap conditions for panels greater than 50', panels should be produced on site but production must be completed by factory technicians.

METAL ROOF PANEL ACCESSORIES

- A. General: Provide complete metal roof panel assembly incorporating trim, copings, fasciae, gutters and downspouts, and miscellaneous flashings, in profiles as indicated. Provide required fasteners, closure strips, splice plates, support plates, and sealants as indicated in manufacturer's written instructions.
- B. Flashing and Trim: Match material, thickness, and finish of metal panel face sheet.
- C. Panel Clips: ASTM A 653/A 653M, G90 (Z180) hot-dip galvanized zinc coating, configured for concealment in panel joints, and identical to clips utilized in tests demonstrating compliance with performance requirements.
- D. Panel Fasteners: Self-tapping screws and other acceptable corrosion-resistant fasteners recommended by roof panel manufacturer. Where exposed fasteners cannot be avoided, supply fasteners with EPDM or neoprene gaskets, with heads matching color of metal panels by means of factory-applied coating.
- E. Joint Sealers: Manufacturer's standard or recommended liquid and preformed sealers and tapes, and as follows:
1. Factory-Applied Seam Sealant: Manufacturer's standard hot-melt type.
 2. Tape Sealers: Manufacturer's standard non-curing butyl tape, AAMA 809.2.
 3. Concealed Joint Sealant: Non-curing butyl, AAMA 809.2.
- F. Steel Sheet Miscellaneous Framing Components: ASTM C 645, with ASTM A 653/A 653M, G60 (Z180) hot-dip galvanized zinc coating.
- G. Pipe Penetration Flashings: Flexible boot type, with stainless steel compression ring, and stainless steel pipe strap. Use silicone-type boot at hot pipes.

- H. Gutters: Formed from same material roof panels. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- (2400-mm-) long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches (900 mm) o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match metal roof panels.
- I. Downspouts: Formed from same material as roof panels. Fabricate in 10-foot- (3-m-) long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish downspouts to match gutters.
- J. Pipe Penetration Flashing: Premolded EPDM pipe collar with flexible aluminum ring bonded to base and stainless steel pipe clamp to secure collar to pipe.
- K. Roof Curbs: Fabricated from aluminum sheet, minimum 0.080 inch (1.2 mm) thick; with bottom of skirt profiled to match roof panel profiles, and welded top box, integral internal fastener flange, and water diverter. Fabricate curb subframing of minimum 0.0598-inch- (1.5-mm-) thick, angle-, C-, or Z-shaped galvanized steel sheet. Fabricate curb and subframing to withstand indicated loads, of size and height indicated. Finish roof curbs to match metal roof panels.
 - 1. Insulate roof curb with 1-inch- (25-mm-) thick, rigid insulation.

FIELD-INSTALLED THERMAL INSULATION

- A. Faced, Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 2 glass-fiber mat, Grade 3, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, based on tests performed on unfaced core. FM Approvals 4450/4470 approved. CFC-, HCFC-, and HFC- free.
 - 1. Minimum thickness: 4.5 inches.
 - 2. Available manufacturer's:
 - a. Tremco: Trisotech
 - b. Atlas: AC Foam II
 - c. Hunter:
 - d. Johns Manville

INSULATION ACCESSORIES

- A. Roof Insulation Cover Board:
 - 1. Gypsum panel, glass-mat-faced, primed, ASTM C1177/C1177M.
 - a. Basis of design product: Tremco/GP Gypsum DensDeck Prime.
 - b. Thickness: 1/2 inch (12 mm).
 - c. Available Manufacturers
 - 1) GP: Dens Deck
 - 2) US Gypsum: Securock

UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: 30 to 40 mils (0.76 to 1.0 mm) thick minimum, 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: Stable after testing at 240 deg F (116 deg C); ASTM D 1970.
2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.
3. Available Manufacturer's
 - a. Tremco
 - b. McElroy
 - c. Carlisle

MISCELLANEOUS METAL FRAMING

- A. Miscellaneous Metal Framing, General: ASTM C 645, cold-formed metallic-coated steel sheet, ASTM A 653/A 653M, G60 (Z180) hot-dip galvanized or coating with equivalent corrosion resistance unless otherwise indicated.
- B. Zee Clips: 0.079-inch (2.01-mm) nominal thickness.
- C. Base or Sill Channels: 0.079-inch (2.01-mm) nominal thickness.
- D. Hat-Shaped, Rigid Furring Channels:
 1. Nominal Thickness: As required to meet performance requirements, but not less than 0.025 inch (0.64 mm).
 2. Depth: As indicated.
- E. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 7/8 inch (22 mm), and depth required to fit insulation thickness indicated.
 1. Nominal Thickness: As required to meet performance requirements.
- F. Fasteners for Miscellaneous Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten miscellaneous metal framing members to substrates.

MISCELLANEOUS MATERIALS

- A. Panel Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal roof panels by means of plastic caps or factory-applied coating. Provide EPDM, PVC, or neoprene sealing washers.

FABRICATION

- A. General: Provide factory fabricated and finished metal panels and accessories meeting performance requirements, indicated profiles, and structural requirements.
- B. Fabricate metal panel joints configured to accept factory-applied sealant providing weathertight seal and preventing metal-to-metal contact and minimizing noise resulting from thermal movement.
- C. Form panels in continuous lengths for full length of detailed runs, except where otherwise indicated on approved shop drawings.

- D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's written instructions, approved shop drawings, and project drawings. Form from materials matching metal panel substrate.

FINISHES

- A. Two coat coil applied, baked on full strength (70% resin, PVF2) fluorocarbon coating consisting of a nominal 0.25 mil dry film thickness primer, and a nominal dry film thickness of 0.7 -0.8 mil color coat for a total 0.9 to 1.1 mil total system dry film thickness. Finish to be selected from manufacturer's standard color selection. The back side of the material should be 0.25 mil primer and a 0.25 mil polyester wash coat.
1. Roof Panel Color:
 - a. Selected from full range of manufacturer's standard colors.
 - b. Color: Refer to Material Schedule for selection.
 2. Roof Related Trim/Accessories Color:
 - a. Selected from full range of manufacturer's standard colors.
 - b. Color: Refer to Material Schedule for selection.

SOURCE QUALITY

- A. Source Quality: Obtain metal panel products from a single manufacturer.
- B. Quality Control: Obtain structural standing seam metal roof panels, trim and other accessories from a manufacturer capable of providing on-site technical support and installation assistance.

MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with manufacturer's product data, recommendations and installation instructions for substrate verification, preparation requirements and installation.
1. Strippable Film: Remove manufacturer's protective film, if any, from surfaces of roofing panels.
- B. 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.
1. Verification of Conditions:
 - a. Panel support systems are ready for construction activities of this section and within specified tolerances.
 - b. Rough-in utilities are in correct locations.
 2. Installer's Examination:
 - a. Have installer of this section examine conditions under which construction activities of this section are to be performed, then submit written notification if such conditions are unacceptable.
 - b. Transmit 2 copies of installer's report to Architect within 24 hours of receipt.
 - c. Delay construction activities of this section until unacceptable conditions have been corrected.
 - d. Beginning construction activities of this section indicates installer's acceptance of conditions.

PREPARATION

- A. Coordination: Coordinate metal roofing with other work to provide a noncorrosive and leak-proof installation.
 - 1. Install substrate boards, hat channels, purlins, or furring channels in accordance with manufacturer's recommendations.
 - 2. Coordinate work, with installation of other associated Work, to ensure quality application.
 - 3. Coordinate work with installation of associated metal flashings and building walls.
 - 4. Coordinate work to minimize foot traffic and construction activity on installed finished surfaces.
 - 5. Coordinate location of pipe penetrations to allow centering of pipe in panel.
 - 6. Coordinate location of roof curbs, to allow proper integration with roof panel.
 - 7. Coordinate work to minimize foot traffic and construction activity on installed finished surfaces.
 - 8. Dissimilar Metals: Prevent galvanic action of dissimilar metals.

THERMAL INSULATION INSTALLATION

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Extend insulation in thickness indicated to cover entire roof. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Seal all joints and penetrations air- and vapor-tight.
- C. Rigid Board Insulation: Install 4.5" insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
 - 1. Where overall insulation thickness is 2 inches (50 mm) or greater, install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.
 - 2. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
- D. Coverboard Installation: Install coverboards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction. Loosely butt coverboards together. Tape joints if required by roofing manufacturer.
 - 1. Attach insulation and coverboard to deck with approved fasteners.
 - 2. Secure insulation to metal panel per FM-1-29 Table 6.

UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Extend underlayment into gutter trough. Roll laps with roller. Cover underlayment within 14 days.
 - 1. Apply over entire roof surface

- B. Install flashings to cover underlayment to comply with requirements specified in Division 07 Section "Sheet Metal Flashing and Trim."

METAL ROOF PANEL INSTALLATION

- A. General: Install metal roofing panels to profiles, patterns and drainage indicated and required for leak-proof installation. Provide for structural and thermal movement of work. Seal joints for leak-proof installation.
1. Shim or otherwise plumb substrates receiving metal panels.
 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws.
 3. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
 4. Install screw fasteners in predrilled holes for clip installation.
 5. Locate and space fasteners in uniform vertical and horizontal alignment.
 6. Install flashing and trim as metal panel work proceeds.
 7. Install continuous length panels if at all possible. If splices are required, locate panel splices over, but not attached to, structural supports.
 8. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws.
 9. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 10. Provide weathertight EPDM Flashing for pipe- and conduit-penetrating panels.
 11. Seams: Provide uniform, neat seams.
 12. Fix panels at location depicted on reviewed shop drawings.
 13. Allow for required panel clearance at penetrations for thermal movement.
 14. Align pipe penetrations to occur at center of roof panel. Report and have corrected improperly placed penetrations before proceeding with panel installation. Remove and replace roof panels which have improperly placed penetration flashings.
 15. Allow for required panel clearance at penetrations for thermal movement.
 16. Fasteners: Conceal fasteners where possible in exposed work. Cover and seal fasteners and anchors for watertight and leak-proof installation.
 17. Sealant-Type Joints: Provide sealant-type joint where indicated. Form joints to conceal sealant. Comply with Division 7 Joint Sealants Section for sealant installation.
- B. Roofing Installation:
1. Install roofing plumb, true and in correct alignment with structural framing, in accordance with shop drawings and manufacturer's printed installation instructions.
 2. Install roofing using manufacturer's concealed fastening system or non-corroding fasteners color-matched to panel.
 3. Install trim using concealed fasteners where possible; sight-exposed non-corroding fasteners color-matched to trim are permitted on vertical surfaces only.
- C. Installation Tolerances:
1. Variation from Plumb: Maximum 1/8" (3.2 mm) in 20 feet (6.096 m).
 2. Variation from Level: Maximum 1/8" (3.2 mm) in 20 feet (6.096 m).
 3. Variation from True Plane: Maximum 1/4" (3.2 mm) in 20 feet (6.096 m).
- D. Accessory Installation: Install accessories using techniques recommended by manufacturer and which will assure positive anchorage to building and weathertight mounting. Provide for thermal movement. Coordinate installation with flashings and other components

- E. Flashing and Trim Installation: Comply with performance requirements, manufacturer's written installation instructions, and the SMACNA "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and install units to true level. Install work with laps, joints, and seams that will be permanently watertight.
- F. Metal Roof Curbs: .063 minimum thickness welded aluminum, or 18 gauge minimum welded stainless steel, factory-insulated, with integral cricket, and designed to fit roof panel module, sized to meet specification.
- G. Gutters: Join sections with riveted and soldered or lapped, riveted, and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches (914 mm) o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- H. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1500 mm) o.c. in between.
 - 1. Provide elbows at base of downspouts to direct water away from building.
 - 2. Connect downspouts to underground drainage system indicated.
- I. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

FIELD QUALITY REQUIREMENTS

- A. Site Tests: (Post-Installation Testing): Owner reserves right to perform post-installation testing of installed metal panel installation.
- B. Manufacturer's Field Services: Upon Owner's request, provide manufacturer's field service consisting of product use recommendations and periodic site visit for inspection of product installation in accordance with manufacturer's instructions.

CLEANING

- A. Cleaning: Remove temporary coverings and protection of adjacent work areas.
- B. Repair or replace damaged installed products.
- C. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance.
- D. Remove construction debris from project site and legally dispose of debris.
- E. Remove strippable coating and perform dry wipe-down cleaning of panels as erected.

PROTECTION

- A. Protection: Protect installed product's finish surfaces from damage during construction:
 - 1. Protect installed products from damage by subsequent construction activities.
 - 2. Replace products having damage other than minor finish damage.

3. Repair products having minor damage to finish in accordance with panel Manufacturer's recommendation
4. Architect shall be sole judge of acceptability of repair to damaged finishes; replace products having rejected repairs

END OF SECTION 07 41 13

SECTION 07 42 16 – METAL SOFFIT PANELS

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

SCOPE

- A. Provide metal soffit panels on framing members at all locations as shown on the drawings.
- B. Install all necessary edge and corner trim pieces, closure panels; concealed fasteners etc. as shown on the drawings or as may be necessary to install a complete watertight assembly.

MATERIALS

- A. Soffit panels shall be McElroy Metals, Marquee-Lok – 12” Smooth Flat panel, 24 gauge, 12” wide galvanized, with a 50,000 PSI yeild. Finish shall be Kynar Signature 300 in color Patrician Bronze.
- B. Trim, flashing and other metal shall be 24 gauge, Galvalume steel with color coating to match soffit panels.

SUBSTITUTIONS

- A. Other metal wall panel manufacturers wishing to bid this project must request prior approval from the Architect for their products.
- B. Submit requests for approval at least four (4) days prior to bid date, so that proper notification of approval, if granted, can be given to all bidders by addendum.
- C. Those requesting prior approval must submit sufficient technical information regarding their products so that the Architect can adequately compare equity to products currently specified. Any and all variations from Architect’s drawings and specifications must be clearly and completely described in request for substitution.

SUBMITTALS

- A. Submit eletronic coppies of shop drawings showing panel layouts, flashing details, trim details, and all other components as required for a complete and watertight system.
- B. Submit two (2) sets of manufacturer’s color samples to the Architect for selection.

APPLICATION

- A. Install metal soffit panels in strict accordance with manufacturer’s written recommendations and instructions. Provide all incidental trim, closures, flashings, etc. as required to install system in accordance with manufacturer’s recommendations and instructions.

FINISHES & WARRANTIES

- A. Color coatings shall be a PDVF, Fluorocarbon meeting both Kynar 500 and Hylar 5000 specifications and shall be warranted for 20 years.

END OF SECTION 07 42 13

SECTION 075416 – KETONE ETHYLENE ESTER (KEE) BASED SHEET ROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Adhered Roofing Systems. (FTR-AD)

1.2 RELATED SECTIONS

- A. Section 03300 - Cast-in-Place Concrete. (03 30 00 - Cast-in-Place Concrete.)
- B. Section 05311 - Steel Deck. (05 31 00 - Steel Decking.)
- C. Section 05360 - Composite Metal Decking. (053600 – Composite Metal Decking.)
- D. Section 06100 - Rough Carpentry. (06 10 00 - Rough Carpentry.)
- E. Section 07270 - Air Barriers. (07 27 00 - Air Barriers.)
- F. Section 07260 - Vapor Retarders. (07 26 00 - Vapor Retarders.)
- G. Section 07720 - Roof Accessories. (07 72 00 - Roof Accessories.)
- H. Section 07500 - Membrane Roofing. (07 50 00 - Membrane Roofing.)
- I. Section 07620 - Sheet Metal Flashing and Trim. (07 62 00 - Sheet Metal Flashing and Trim.)

1.3 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM D6754 - Standard Specification for Ketone Ethylene Ester Based Sheet Roofing.
 - 2. ASTM D312 - Standard Specification for Asphalt Used in Roofing.
 - 3. ASTM D4601 - Standard Specification for Asphalt-Coated Glass Fiber Base Sheet Used in Roofing.
 - 4. ASTM D4897 - Standard Specification for Asphalt-Coated Glass Fiber Venting Base Sheet Used in Roofing.
 - 5. ASTM D 7654 - Standard Specification for Asphalt Used in Roofing Measured by Dynamic Shear Rheometer.
 - 6. ASTM C 1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
 - 7. ASTM C473 - Standard Test Methods for Physical Testing of Gypsum Panel Products.
 - 8. ASTM D6163 - Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements.
 - 9. ASTM D6164 - Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements.
- B. American Society of Civil Engineers (ASCE):
 - 1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.
- C. FM Approvals (FM):
 - 1. FM Standard 4470 - Single-Ply, Polymer-Modified Bitumen Sheet, Built-Up Roof (BUR) and Liquid Applied Roof Assemblies for use in Class 1 and Noncombustible Roof Deck Construction.
 - 2. Loss Prevention Data Sheets 1-28, 1-29.
- D. UL - Fire Resistance Directory.

1. UL-790 - Standard Test Method for Fire Tests of Roof Coverings.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300 (01 30 00) - Administrative Requirements.
- B. Product Data:
 1. Most recent published technical literature and guide specifications issued by FiberTite Technical Services (FTS).
 2. Authorized Applicator's approved copy of FiberTite Project Registration.
 3. Preparation instructions and recommendations.
 4. Storage and handling requirements and recommendations.
 5. Typical installation methods.
 6. Dimensioned shop drawings, including roof plan detailing perimeter enhancement, flashing methods, terminations and acceptance by FTS.
 7. Written approval from FTS confirming any accessories submitted, not manufactured or expressly approved in FiberTite literature are acceptable and compatible with the proposed FiberTite Roofing System.
 8. Safety Data Sheets (SDS) relating to all products, chemicals and solvents.
 9. Certification that the system specified complies with identifiable building code and insurance requirements.
 10. FiberTite roofing systems (FTR) References:
 - a. FTR GS 01/21 FiberTite General Guide Specification.
 - b. FiberTite Construction Details.
 - c. FiberTite Foreman's Manual.
 - d. FiberTite Technical Bulletins
- C. Verification Samples: Two representative units of each type, size, pattern and color.
- D. Shop Drawings: Include details of materials, construction and finish. Include relationship with adjacent construction.
- E. For Project Registration and Warranty Acceptance: FTS will review the following.
 1. Complete copy of project architectural specifications or Authorized Applicator's proposal outlining design parameters.
 2. Complete list of accessories or materials not manufactured or expressly authorized for use in FiberTite literature.
 3. Dimensioned outline of the roof indicating all FTR-Detail references.
 4. Dimensioned shop drawings illustrating non-FiberTite details. Details that do not conform with standard FiberTite details shall be returned with appropriate recommendations.

1.5 QUALITY ASSURANCE

- A. FiberTite Roofing Systems shall be installed only by an Applicator, authorized by Seaman Corporation to install FiberTite Roofing Systems prior to bid or contract award. Herein, the term Authorized FiberTite Applicator is synonymous with Applicator.
- B. Authorized Applicator's key personnel shall have received specialized training by Seaman Corporation.
- C. FiberTite Roofing Systems shall be installed in accordance with the most current guide specifications and details as amended or authorized by FTS for specific project requirements.
- D. There shall be no deviations from approved contract specifications or shop drawings without prior written approval by the Owner/Owner representative and FTS.
- E. Unauthorized deviations may subject the roof system to warranty ineligibility.

- F. All work found to be substandard or in violation manufacturer's specifications shall be subject to rejection including complete removal and replacement with new materials at the expense of the Contractor.
- G. A quality assurance inspection of the roof system shall be performed by FTS for acceptance and approval. This inspection shall be performed upon completion and certification by the Applicator that the FiberTite Roofing System has reached 100 percent completion, a quality installation has been completed in accordance with the approved contract specifications, and all field welds have been probed and inspected.
- H. All field seams shall be visible and available to FTS at the time of final inspection.

1.6 COORDINATION

- A. Prior to installation of materials, a pre-roofing conference shall be held with the Applicator, and Owner or Owner's Representatives to discuss the specified roofing system, coordinate its proper application and the expectations of all parties involved. The Authorized Applicator and the Owner or Owner's representative shall notify all parties a minimum of fourteen days prior to the meeting.
- B. Plan and coordinate the installation of the roofing system with other trades in such a manner to avoid membrane damage, keeping the complete installation weather tight and in accordance with all approved details and warranty requirements.
- C. FTS shall be available to make recommendations necessary to ensure compliance with project specifications and specification alternatives due to unforeseen job conditions.
- D. Field services are provided at the discretion of Seaman Corporation. A minimum two weeks' notice is required to evaluate and coordinate any request for onsite technical assistance.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all materials to the job site in manufacturer's original, unopened containers, with legible labels and in sufficient quantity to allow for continuity of work.
- B. Store and handle in strict compliance with manufacturer's written instructions and recommendations.
 - 1. Store rolls of membrane lying down, elevated above the roof deck and completely protected from moisture with tarpaulins. Manufacturer's packaging is not considered adequate for outdoor storage.
 - 2. Elevate Insulation and cover board materials on pallets and fully protect from moisture with tarpaulins. Manufacturer's packaging is not considered adequate protection from moisture.
 - 3. Store adhesives and sealants between 50 and 80-degrees F (10 and 26.7 degrees C) prior to use.
 - 4. Store flammable materials in cool dry areas away from sparks and open flames.
 - 5. Follow all precautions as outlined in manufacturer's material safety data sheets.
- C. Materials, having been determined by the Owner or Owner's representative to be damaged, shall be immediately removed from the construction site and replaced at no cost to the Owner.

1.8 JOB CONDITIONS

- A. Safety:
 - 1. Take necessary precautions regarding worker health and safety when using solvents, adhesives or hot asphalt.
 - 2. Worker safety is paramount.
 - 3. FiberTite is slippery when wet, exhibits dew, frost, ice or other form of moisture.
 - 4. Comply with OSHA requirements for roof construction and fall protection.
 - 5. Store flammable liquid and materials away from open sparks, flames and extreme heat.

6. Take necessary precautions when using solvents and adhesives.
 7. Daily site cleanup to minimize debris and hazardous congestion.
- B. Protection:
1. Schedule installation sequence to limit access and utilization of installed membrane for material storage, construction staging, mechanical and excessive foot traffic.
 2. Provide proper protection on newly completed roofing.
 3. Minimize traffic on freshly laid roofing.
 4. Protect walls, rooftop units, windows and other components during installation.
- C. Additional Precautions:
1. Adverse weather conditions, e.g. extreme temperature, high winds, high humidity and moisture, could have a detrimental effect on adhesives, general production efforts and the quality of the finished installation.
 2. Daily production schedules shall be limited to what can be made 100 percent watertight at the end of each day, including flashing and night seals.
 3. All surfaces to receive the new roof system, including insulation and flashing, shall be free from all dirt, debris and be thoroughly dry.
 4. Comply with local EPA requirements as published by local, state and federal authorities.
 5. During the construction process temporary ballast, especially in the perimeter and corner areas may be required to provide protection against high winds.

1.9 DESIGN CONDITIONS

- A. This specification is applicable to only those building roofs that have decking of sufficient structural integrity, capable of supporting a FiberTite Roofing System.
- B. Applications and project specifications require review by FiberTite Technical Services (FTS) for acceptance prior to commitment to provide a commercial warranty.
- C. Seaman Corporation Project Registration, must be completed, signed by an Authorized Applicator, submitted to and approved by FTS before any consideration for warranty or the release of any materials can be authorized.
- D. Special Design Considerations:
1. The building Owner may be required to submit an engineering study, or Statement of Sound Roof Structure, to FTS, indicating that the structure is able to accommodate additional live and dead loads including snow and water retention.
 2. Moisture conditions in existing roofs, new structural concrete or new lightweight insulating concrete that would impair or prohibit the desired performance of the new roof system.
 3. Coal tar recover or direct contact with bituminous materials.
 4. Positive slope to promote adequate drainage to avoid the potential damage to the substrate or components.
 5. Roof areas subject to heavy or excessive mechanical traffic.
- E. Exterior Fire Test Exposure: Roof system shall achieve a FM or UL Class rating for roof slopes indicated as follows:
1. FM Approvals Class A Rating.
 2. Underwriters Laboratory Class A Rating.
- F. Design Requirements:
1. Uniform Wind Uplift Load Capacity
 - a. Installed roof system shall withstand negative (uplift) design wind loading pressures complying with the following criteria.
 - 1) Design Code: ASCE 7, Method 2 for Components and Cladding.
 2. Dead Load:

- a. Installation of new roofing materials shall not exceed the dead load capacity of the existing roof structure.
- G. Roof system membrane and components shall be labeled to demonstrate compliance with quality follow up services from the following entities:
1. Underwriters Laboratories:
 2. FM Approvals:
 - a. For building owners insured by FM Global, submit applicable RoofNav number(s).
- H. Energy Star: Roof System shall comply with the initial and aged reflectivity required by the U.S. Federal Government's Energy Star program.
- I. Roof system shall have been tested in compliance with the following codes and test requirements:
1. Florida FBC (For use outside Miami-Dade and Broward Counties):
 - a. Membrane Systems FL 4930
 2. Miami-Dade County:
 - a. Membrane Systems Over:
 - 1) Steel Decks N.O.A. 20041410.
 - 2) Cementitious Wood Fiber Decks N.O.A 20041412.
 3. Cool Roof Rating Council:
 - a. CRRC Directory CRRC 0634.
 4. Underwriters Laboratories:
 - a. Certification TGFU.R 10117.
- J. Environmental Considerations:
1. Environmental conditions such as fog, dew, rain or snow and freezing temperatures can have a detrimental effect on the application and performance of adhesives.
 2. Compliance with EPA and OSHA requirements as published by local, state and federal authorities.
 3. Adhesives can be described as temperamental. The Contractor must be aware of potential environmental variables when installing adhered roofing systems.
 4. Pay attention to and follow adhesive storage and application precautions and guidelines.
 5. Do not apply waterborne adhesives (FTR-490 or FTR-390) if the ambient air temperature is expected to drop below 32 degrees F (0 degrees C) within 72 hours of application.
 6. The use of polystyrene insulation and coverboard assemblies for adhered roofing systems incorporating solvent borne adhesives shall also include a minimum 10-mil polyethylene solvent barrier between the insulation and coverboard.

1.10 WARRANTY

- A. Upon Inspection and Acceptance by a FiberTite Technical Service Representative: Seaman Corporation will issue the preauthorized warranty, subject to the terms and conditions of the sample warranty.
1. Warranty Type:
 - a. Membrane Warranty provides the building owner protection against the cost of repairing defects in the membrane only. This warranty is offered at no cost to the owner.
 - b. Standard Warranty provides the building owner protection against the cost of repairing leaks as a direct result of either defects in the membrane or the workmanship involved in its installation for a period of 10-years. There is a nominal premium.
 - c. Extended Warranty provides the building owner protection against the cost of repairing leaks as a direct result of either defects in the membrane or the workmanship involved in its installation beyond ten-years. There is an additional premium.

2. Maintenance Requirements: A set of instructions included detailing preventative maintenance requirements on the part of the building Owner and noting a list of harmful substances that may damage the FiberTite membrane.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: FiberTite, Seaman Corporation, which is located at: 1000 Venture Boulevard; Wooster, OH 44691-9360; Toll Free Tel: 800-927-8578; Tel: 330-262-1111; Fax: 800-649-2737; Email: marketing@seamancorp.com; Web: <https://www.fibertite.com>

2.2 GENERAL

- A. All products and components for the FiberTite Roofing System shall be supplied by Seaman Corporation.
- B. Components other than those manufactured and supplied by Seaman Corporation shall be submitted for review, prior to ordering. Any products not specifically authorized in writing for the project by Seaman Corporation, shall be considered unacceptable and their performance excluded from the warranty.
- C. FiberTite Roofing Systems may be installed over or directly to pre-approved insulation, cover board or composites thereof. Contact FTS for additional information regarding compatible substrates.

2.3 MEMBRANE

- A. Standards Compliance: ASTM D6754 - 15 Standard Specification for Ketone Ethylene Ester (KEE) Based Sheet Roofing.
- B. Physical Properties: See associated data sheets.
- C. Acceptable Substrate:
 1. Authorized rigid insulation or cover board.
 2. Insulated steel decking.
 3. Existing aggregate surfaced bituminous roof with authorized insulation or cover board.
 4. Authorized base sheet with an adhered insulation and coverboard assembly.
 5. Structural concrete, insulated or non-insulated.
 6. Existing smooth surfaced or granulated bituminous roof or existing single ply roof membrane.
 7. Exterior grade plywood; insulated or non-insulated.
 8. Cementitious fiber or gypsum; insulated or non-insulated.
 9. Cellular, lightweight insulating concrete.
- D. FiberTite Membranes:
 1. FiberTite 36-mil Membrane: Nominal 36 mil (0.91 mm) ketone ethylene ester (KEE) membrane reinforced with 5.0 oz per sq. yd (169.5 grams per sq m) knitted polyester fabric.
- E. Flashing Membrane:
 1. Requirements to match field membrane and warranty expectations selected for roofing system.
 - a. FiberTite Nominal 36 mil (0.91 mm).

2.4 ANCILLARY MATERIALS

- A. FiberTite Membrane Adhesives:

1. Alpha-Tite: VOC compliant solvent borne, contact (two-sided) bonding adhesive for bonding smooth-back FiberTite membranes to properly prepared and preauthorized horizontal and vertical substrates.
 2. FTR-190e: VOC compliant solvent borne, contact (two-sided) bonding adhesive, for bonding smooth-back FiberTite membranes to properly prepared and preauthorized horizontal and vertical substrates.
 3. Hot Asphalt: Asphalt shall be Type III or Type IV steep asphalt, according to ASTM D312.
- B. Flashing Adhesives:
1. Alpha-Tite: VOC compliant solvent borne, contact (two-sided) bonding adhesive for bonding smooth-back FiberTite membranes to properly prepared and preauthorized horizontal and vertical substrates.
 2. FTR-190e: VOC compliant solvent borne, contact (two-sided) bonding adhesive, for bonding smooth-back FiberTite membranes to properly prepared and preauthorized horizontal and vertical substrates.
 3. FTR-201 Mastic: Trowel grade elastomeric adhesive and sealant used to adhere FiberTite flashing membranes to pre-approved vertical substrates.
- C. Fasteners:
1. Securing membranes to steel, wood and structural concrete decks.
 - a. FiberTite MAGNUM Series: No. 15-13, buttress threaded, No. 3 Phillips head fastener constructed of case-hardened carbon steel with a reduced diameter drill point and corrosion resistant coating.
 2. Securing insulation to steel, wood and structural concrete decks.
 - a. FiberTite-HD: No. 14-13, heavy duty threaded steel No. 3 Phillips truss, self-tapping corrosion resistant fastener.
 3. Secure insulation, base sheet or membrane to steel, wood, cement fiber, tectum fiberglass and lightweight plank decks.
 - a. FiberTite Peel Rivets: Threadless, high magnesium alloy fastener.
 4. Secure base sheets to gypsum and cellular lightweight insulating concrete decks.
 - a. FiberTite BS Fasteners: Coated fastener and stress plate
- D. FTR Stress Plates: Used to anchor membranes.
1. FTR Magnum Plus: 1.5 x 2.75 inch (38 x 70 mm) Barbed Rectangular Stress Plate with radial corners; 18 gauge AZ-50 galvalume steel.
 2. FTR Magnum R275: 2.75 inch (70 mm) Barbed Round Stress Plate; 20 gauge galvanized steel.
 3. FTR Magnum 2S: 2.375 inch (60 mm) Barbed Round Stress Plate; 20 gauge galvanized steel.
 4. FTR 3 inch (76 mm) Metal Round Insulation Stress Plates: Finish: AZ-50 galvalume. Flat and flush profile for use on rigid board surfaces.
- E. Additional Components:
1. Flashing Terminations Sealant: FTR-101. Single-component gun-grade polyether.
 2. Sealant for Pitch Pans: FTR-SLS Sealant. Single -component self-leveling polyether.
 3. Fabricated Metal Flashing: FiberClad Metal. 48 x 120-inch (1219 x 3048 mm) sheets.
 - a. Steel: 24-gauge hot dipped G-90.
 - b. Aluminum 300H14: 0.040 inch (1.02 mm) thick laminated with a 0.02 mil (0.0005 mm) polymeric coating. (Can be painted with FTB-Kynar Primer followed by FTB-Kynar Touch Up Paint.)
 4. FTR Pre-molded Flashings: Injection molded vent stack, split Wrapid Flash and inside and outside corner flashing using FiberTite vinyl compound.
 5. FTR Non-Reinforced Membrane: Field fabrication membrane, 60 mil (1.5 mm) non-reinforced vinyl membrane.
 6. FTR SBS Adhesive: A cold process low-VOC, low odor and solvent free SBS modified adhesive for bonding FiberTite SBS Base Sheets to approved substrates.

7. FTR SA Primer: A blend of synthetic polymers, solvents and resins, low VOC primer for VaporTite self-adhered vapor retarder.
8. Forti-Lock: A rapid-curing, proprietary formulation of polymethyl-methacrylate (PMMA) liquid flashing resin. Forti-Lock is combined with Forti-Lock Primer and Forti-Lock Fleece reinforcing fabric to form a flexible and monolithic, reinforced membrane used in aberrant FiberTite flashing and detail applications.
9. Forti-Lock Metal Primer: An acrylic primer used with various metal substrates to promote adhesion of Forti-Lock™ waterproofing and surfacing components.
10. Forti-Lock Fleece: a proprietary non-woven polyester reinforcement used in Forti-Lock liquid flashing applications. Walkway and Protection Pads: FTR-Tuff Track. High grade walkway and protection material with slip-resistant design.
11. FTR-Termination Bar: Membrane flashings restraint and termination seals. 0.125 x 1 x 120 inch (3 x 25 x 3048 mm) 6060-T5 extruded aluminum bar with pre-punched slots, 8 inches (203 mm) on center.
12. FiberTite Metal Fascia System: Two piece "snap-on" pre-formed, architectural Kynar metal edge systems.
13. FTR-Value Insulation: Polyisocyanurate and extruded polystyrene flat or tapered insulation.
14. FTR-601 & FTR-601 PG: Dual component, single bead (ribbon applied) urethane insulation adhesive. Adhesive is a non-solvent, elastomeric, urethane adhesive, specifically designed for bonding single or multiple layers of roof insulation and insulation composites or cover boards to structural roof decks and base sheets.
15. FiberTite Seam Cleaner: FiberTite Seam Cleaner is to be used with clean white cotton cloths or rags to clean contamination from the seam areas of the membrane prior to welding.
16. Simulated Metal Roofing Profile (Rib): Co-Extruded Ornamental Profile with a KEE compatible heat-activated adhesive as provided by Seaman Corporation.
 - a. Extruded profile shall be provided in 100 feet (30.5 m) continuous lengths and match fleece back membrane color.
17. FTR T Joint Covers: Pre-cut 4 x 4 inch (102 x 102 mm) 60 mil (1.5 mm) non-reinforced membrane to reinforce areas where three overlapping sheets of membrane intersect.

2.5 VAPOR RETARDERS

- A. Vapor Retarders:
 1. The decision regarding the inclusion of a vapor retarder within the roof system shall fall within the responsibility of the design professional. Consult N.R.C.A. or other technical resource for appropriate guidelines.
 2. Vapor retarder for use in a FiberTite roof system shall comply with identifiable code and/or insurance requirements.
 3. Preapproved vapor retarders shall be installed, where specified or required, to meet project design requirements and provide a suitable surface for installation of the FiberTite Roofing System.
 4. Acceptable products must be preapproved or approved in writing by Seaman Corporation.
 5. Pre-authorized Products:
 - a. VaporTite.
 - b. FiberTite SBS Base Sheets
 - c. Minimum 6-mil Polyethylene

2.6 INSULATION

- A. Insulation shall be installed, where specified or required to provide a suitable surface for the FiberTite Roofing Systems and meet desired thermal values.
- B. Products must be pre-approved in writing by Seaman Corporation and comply with minimal characteristics and classification listed for the products below:
 1. Polyisocyanurate Rigid Insulation (ASTM C1289):
 - a. FTR-Value Brand Polyisocyanurate Rigid Insulation.

2. XPS Rigid Insulation (ASTM D1621):
 - a. FTR-Value Brand XPS Rigid Insulation
 3. Gypsum Core Cover Board and or Substrate Board (ASTM C473):
 - a. National Gypsum DEXcell.
 - b. Georgia-Pacific Gypsum LLC Dens Deck Prime
 - c. United States Gypsum Company SECUROCK.
- C. Adhesives for Insulation Attachment: Preauthorized by Seaman Corporation.
1. Listed and approved by FM Approvals in conjunction with specified insulation and substrate.
 2. Meet minimum roofing system design requirements, evidenced by testing in conjunction with the proposed substrate and or composite.
 - a. Testing to be performed under FM Global requirements or acceptable third-party laboratory.
 3. Provide written specifications regarding the safe handling, storage and surface preparation for a quality application of the product.
 4. Insulation Adhesives:
 - a. Polyurethane Adhesive: Either a dual or single component polyurethane, dispensed from a portable pressurized container or traditional foam equipment.
 - 1) Preapproved Products:
 - a) FTR-601.
 - b) FTR-601 PG.
 - c) Polyset CR20.
 - b. Hot Asphalt:
 - 1) Asphalt shall be Type III or Type IV steep asphalt, according to ASTM D312.
 - 2) Asphalt shall be applied within 25 degrees F (minus 3.9 degrees C) of the asphalt manufacturer's recommended Equiviscous Temperature (EVT). If the manufacturer does not supply the EVT Seaman Corporation recommends a temperature range of 425 degrees F (218 degrees C) for mopping and 450 degrees F (232 degrees C) for mechanical spreaders. Asphalt applied within 25 degrees F (minus 3.9 degrees C) of the EVT, under normal environmental conditions; will provide a nominal 23 to 25 lbs (10.4 to 11.3 kg) of asphalt per 100 sq ft (9.3 sq ft).
 - 3) The roofing contractor is responsible for maintaining the temperature tolerances at the kettle as well as the rooftop at all times.
 - 4) Cold weather application can cause significant drops in the temperature of the asphalt during transport to the roof and points of application. Insulated equipment is recommended during cold weather applications.
 - 5) All projects utilizing hot asphalt for insulation securement require written authorization, prior to the bidding process, by Seaman Corporation.

2.7 RELATED MATERIALS

- A. Wood Nailers: No. 2 or better construction grade lumber.
1. Installation of other types of treated lumber should be verified with a design professional.
 2. Creosote or asphaltic type preservatives are not acceptable.
 3. Top Nailer Thickness; 1.5 inches (38 mm) minimum.

2.8 BASE SHEET

- A. Base Sheets:
1. Preapproved base sheet shall be installed, where specified or required, to provide a suitable surface for installation over or adhering the insulation or FiberTite-FB Roofing System.
 2. Acceptable products must be preapproved or approved in writing by Seaman Corporation and comply with the following minimal characteristics and classifications.
 - a. ASTM D4601 Type II Asphalt Coated Glass-Fiber Base Sheet.
 - b. ASTM D4897 Type II Asphalt Coated Glass-Fiber Venting Base Sheet.
 - c. ASTM D6163, Type 1, Grade S, FiberTite SBS Membrane.

- d. ASTM D6164, Type 1, Grade S, FiberTite SBS Membrane.

PART 3 EXECUTION

3.1 GENERAL

- A. Authorized Applicator: Ensure strict compliance with FTR GS 01/21; General Guide Specifications for Installation of FiberTite Roofing Systems.
 - 1. Provide suitable substrate surface for proper installation of roofing system, roof insulation and specified components.
 - 2. Coordinate installation ensuring system remains watertight at end of each working day.
- B. Application of Seaman Corporation/FiberTite materials constitutes an agreement that Authorized Applicator has inspected and found the substrate suitable for installation of roofing system.

3.2 SUBSTRATE PREPARATION

- A. Authorized Applicator: Verify the deck condition or existing roof construction is suitable for the specified installation.
- B. Seaman Corporation requires fastener withdrawal values (pull out tests) on roofing projects to verify suitability of decking to accept a mechanically fastened insulation or membrane roof system.
- C. Examine surfaces for inadequate anchorage, low areas that will not drain properly, foreign material, ice, wet insulation, unevenness or any other defect which would prevent the proper execution and quality application roofing system as specified.
- D. Prepared substrate shall be smooth, dry, and free of debris or any other irregularities which would interfere with proper installation.
- E. The application of adhesives or hot asphalt directly to structural concrete, gypsum, Tectum, lightweight insulating concrete, existing smooth or granulated BUR materials may require sealing or priming with an appropriate elastomeric or asphalt primer prior to application.
- F. Adhesives will not bond to wet, damp or inadequately cured lightweight insulating concrete or poured structural concrete.
- G. Do not proceed with any part of the application until all defects and preparation work have been corrected and complete.

3.3 SUBSTRATE PREPARATION (NEW CONSTRUCTION)

- A. Steel Deck:
 - 1. Steel decking shall conform to FM guidelines for Class-1 insulated steel deck construction.
 - 2. Steel decking shall be constructed of a minimum 22-gauge cold rolled steel sheets with factory G-90 galvanized coating.
 - 3. Panel profiles (ribs) shall be formed to minimize deflection and provide suitable strength and integrity to support anticipated structural live and dead loads.
 - 4. Steel decking shall be installed in compliance with specified design criteria and local building code requirements.
 - 5. Steel decking that is less than 22-gauge may be considered for application by Seaman Corporation. Fastener withdrawal tests shall be performed on all non-FM Approved steel decking, (decking less than 22-gauge) to determine suitability and appropriate fastener patterns and densities for mechanical attachment of the new components of the FiberTite Adhered Roofing Systems.
- B. Cementitious Fiber:

1. Molded panels shall be installed in strict accordance with the manufacturer's installation requirements.
2. Decking should be installed to provide positive slope and subsequent positive drainage of the new FiberTite Roofing System.
3. Vertical alignment between adjacent panels shall provide a uniform substrate. Alignment differences shall be no greater than 0.125 inch (3 mm) and shall be leveled with cementitious grout.
4. Fastener withdrawal tests shall be performed on all cement fiber decking to determine suitability for and appropriate fastener patterns for the components of the new FiberTite Roofing System.

3.4 WOOD NAILERS

- A. Install treated lumber at same heights as insulation layer or adjacent construction plus or minus 0.25 inch (6 mm). Install continuous treated wood nailers at all perimeters, around roof projections and penetrations as shown in approved details.
- B. Wood Nailers Installed Directly on the Substrate: Carefully examine substrates to confirm the entire area provides a suitable fastening surface. Repair defects by appropriate trades prior to installation.
- C. Nailers (W x H): 3.5 x 1.5 inches (89 x 38 mm). Installed and anchored in such a manner to resist a force of 250 lbs per linear foot (2.919 kN per m) of wood blocking in any direction.
- D. Nailers along parapets, curbs and expansion joints are recommended for insulated decking. Consult FiberTite Construction Details or FiberTite Technical Customer Services for optional and alternate membrane termination and securement methods.

3.5 BASE SHEET

- A. General:
 1. Approved base sheet, when required or specified, shall be applied only to properly prepared and preapproved substrates.
 2. Install no more than can be covered or made 100 percent water tight during the same working day.
 3. Field pull-out tests must be performed for mechanically attached base sheets to determine fastener withdrawal performance.
 4. Base sheets shall be installed starting at the low point of the roof deck.
 5. Base sheet shall be side lapped, a minimum of 3 inches (75 mm), and properly shingled to shed water.
- B. Mechanically Attached Base Sheet:
 1. All base ply fasteners and stress plates for the mechanical attachment of base sheets shall be provided by Seaman Corporation.
 2. For 1-90 attachment, approved base sheet is secured to the deck in the field of the roof, with FiberTite Fasteners, spaced a maximum of 7 inches (178 mm) on center through the minimum 3 inch (76 mm) side laps and staggered at a maximum 7 inch (178 mm) on center in two rows within the field of the sheet.
 3. The number of fasteners securing the base sheet shall be increased over the field spacing by 70 percent in the perimeter and 160 percent in the corners of the roof area.
 4. Fastening increases can be obtained by adding rows of fasteners or additional fasteners along each row.
- C. Torch Applied Base Sheet:
 1. FTR SBS Base Sheets shall be applied only to properly prepared and preapproved substrates, free of any debris, dirt, grease, oil or moisture.
 2. Follow all safety guidelines and or NRCA CERTA requirements when torching.

3. Base sheet shall be fully bonded to the substrate.

D. Base Sheet Adhered with Hot Asphalt:

1. Hot asphalt shall be applied only to properly prepared and preapproved substrates, free of any debris, dirt, grease, oil or moisture.
2. Base sheet shall be embedded into a fluid, continuous application of hot Type III steep asphalt at a minimum application rate of 25 lbs (11.3 kg) per 100 sq ft (9.3 sq m).
3. Base sheet shall be fully bonded to the substrate.

3.6 VAPOR RETARDERS

A. General:

1. Approved vapor retarder, when required or specified, shall be applied only to properly prepared and preapproved substrates.
2. Install no more than can be covered or made 100 percent water tight during the same working day.
3. Vapor retarders shall be installed starting at the low point of the roof deck.
4. Vapor retarder shall be side lapped, a minimum of 3 inches (75 mm), and properly shingled to shed water.

- B. VaporTite: Install one ply sheet over the entire prepared substrate. Shingle in direction of slope of roof to shed water on each area of roof.

- C. Hot Applied Vapor Retarder: Install one ply sheet in 25 lbs. per square (11.3kg) of ASTM D 312 Type III bitumen over the entire prepared substrate. Shingle in direction of slope of roof to shed water on each area of roof.

- D. Torch Applied Vapor Retarder: Install torch grade FTR SBS Base Sheet using a suitable heat source to adhere one ply to the entire surface. Shingle in direction of slope of roof to shed water on each area of roof.

- E. Cold Applied Vapor Retarder: Install one ply sheet in FiberTite SBS Base Sheet, cold applied in FTR SBS Adhesive over the entire prepared substrate. Shingle in direction of slope of roof to shed water on each area of roof.

- F. Two Ply Fiberglass Vapor Retarder: Install two fiberglass ply sheets in 25 lbs. per square (11.3kg) of ASTM D 312 Type III bitumen shingled uniformly to achieve two plies over the entire prepared substrate. Shingle in direction of slope of roof to shed water on each area of roof.

3.7 ROOF INSULATION AND COVERBOARD INSTALLATION

A. General:

1. Insulation Boards: Adhered in approved adhesives. Maximum 4 x 4 ft (1219 x 1219 mm).
2. Insulation Boards: Mechanically fastened. 4 x 4 ft (1219 x 1219 mm) or 4 x 8 ft (1219 x 2438 mm).
3. Gypsum Coverboards: Adhered in approved adhesives. 4 x 4 ft (1219 x 1219 mm) or 4 x 8 ft (1219 x 2438 mm).
4. Gypsum Coverboards: Mechanically fastened. 4 x 4 ft (1219 x 1219 mm) or 4 x 8 ft (1219 x 2438 mm).
5. Roof Insulation and Coverboards: Installed where by the long dimension of the boards run in parallel alignment and the short dimensions are staggered a minimum of 12 inches (305 mm).
6. Install insulation with minimum joint dimensions and tightly butted where possible.
 - a. Maximum Joint Widths: 3/8 inch (9.5 mm).
 - b. Damaged Corners: Cut out and replaced with an insulation piece a minimum of 12 x 12 inches (305 x 305 mm). Pieces that are cut from larger panels and are smaller than one square foot are not acceptable.

7. Install no more than can be covered during the same working day.
 8. Taper roof insulation to drain sumps using tapered edge strips.
 - a. If insulation layer is 1.5 inches (38 mm) or less, taper 12 inches (305 mm) from drain bowl.
 - b. If insulation thickness exceeds 1.5 inches (38 mm), taper 18 inches (457 mm) from drain bowl.
 - c. Taper boards or pieces must be adhered or mechanically fastened with a minimum of two fasteners per board.
 9. When a cover board or multiple layers are installed each layer must be offset from the previous layer a minimum of 12 inches (305 mm) on center.
 10. At the end of each working day, provide a watertight cover on all unused insulation as to avoid moisture penetration.
- B. Mechanically Attached Insulation:
1. Apply insulation over properly prepared and pre-approved substrates, free of any debris, dirt, grease, oil or moisture.
 2. Fasteners and stress plates for the mechanical attachment of insulation or coverboard materials shall be FTR Fasteners as provided by Seaman Corporation.
 3. Fasteners and stress plates shall be FM approved for mechanical attachment of insulation and comply with FM Standard 4470 for corrosion resistance.
 4. Attachment 1-90 for insulation and coverboard in the field of the roof requires 1 fastener and stress plate per 2 sq ft (0.186 sq m) of insulation, when the top layer is less than 2 inches (51 mm) thick and the membrane is adhered.
 - a. Perimeter areas require a 50 percent increase in the fastener density.
 - b. Corner areas require a 100 percent increase in the fastener density.
 5. Attachment 1-90 for insulation and coverboard in the field of the roof requires 1 fastener and stress plate per 4 sq ft (0.372 sq m) of insulation, when the top layer is greater than or equal to 2 inches (51 mm) thick and the membrane is adhered.
 - a. Perimeter areas require a 50 percent increase in the fastener density.
 - b. Corner areas require a 100 percent increase in the fastener density.
 6. Roof insulation shall be fastened in accordance with the roof insulation manufacturer's recommendations and must be approved by the FTCS.
 7. Adhered roof systems incorporating mechanically attached insulations and coverboards may require mechanically fastened perimeter and corner membranes systems to comply with guidelines articulated in FM LPD 1-29.
 8. Fasteners shall be installed in accordance with manufacturer's recommendations, complying with minimum penetration requirements for specific deck types.
 9. Fasteners shall be installed using depth sensing tool attachments to ensure proper installation.
- C. Adhered Insulation:
1. Polyurethane:
 - a. Adhesive shall be applied only to properly prepared and pre-approved substrates, free of any debris, dirt, grease, oil or moisture.
 - b. The minimum product temperature at time of application shall be 70 degrees F (21 degrees C).
 - c. Adhesives shall not be applied when surface or ambient temperatures are below 40 degrees F (4.4 degrees C) or above 110 degrees F (43.3 degrees C).
 - d. Insulation shall be fully bonded to the substrate with a maximum board size of 48 x 48 inches (1219 x 1219 mm).
 - e. Insulation shall be set into a continuous 0.5 inch (13 mm) bead of adhesive at a minimum rate of one linear foot of adhesive for every 1 sq ft (0.093 sq m) of insulation board.
 - f. Adhesive rates are to be increased in roof perimeter and corner zones according to specific project requirements and manufacturer's design recommendations.

- g. Place the boards onto the adhesive beads and walk on the boards, spreading the adhesive for maximum contact.
 - h. A second walking may be required after 10 minutes to ensure maximum contact and bond strength.
2. Hot Asphalt:
- a. Hot asphalt shall be applied only to properly prepared and pre-approved substrates, free of any debris, dirt, grease, oil or moisture.
 - b. Insulation shall be set into a continuous flood coat of hot Type III or IV steep asphalt applied to compatible substrate or properly attached base sheet and vapor retarder at a minimum application rate of 25 lbs per 100 sq ft (9.3 sq m).
 - c. Insulation shall be fully bonded to the substrate with a maximum board size of 48 x 48 inches (1219 x 1219 mm).
 - d. Insulation shall be laid in such a manner to avoid squeezing hot asphalt between insulation joints.
 - e. Adhered insulation application may require mechanical enhancement of exterior perimeter and corner areas as outlined in FM LPD 1-29.

3.8 INSTALLATION OF MEMBRANES

A. Quality Control:

1. It is the responsibility of the Authorized Applicator to initiate and maintain a Quality Control program to govern all aspects of the installation.
2. The project foreman and or supervisor will be responsible for the daily execution of the Quality Control program which will include but is not limited to the supervision, inspection and probing of all heat welded seams incorporated within roofing system.
3. If inconsistencies in quality of the application of the composite, membrane or welds are found, work shall cease until corrective actions are taken to ensure the continuity the installation.

B. General:

1. Coordinate work ensuring that sequencing of installation promotes a 100 percent watertight installation at the end of each day.
2. Roofing systems to be designed utilizing and determined to be in compliance with the procedures outlined within the current publication of ASCE7 . Alternative designs may be determined using the criteria within FM Loss Prevention Data.
3. An Adhered FiberTite Roofing Systems may utilize 74-in or 100-in smooth-back roll goods.
4. An Adhered FiberTite Roofing System may utilize 72-fleece back roll goods.
5. Restrictions regarding outside ambient air temperature are relative only to the exposure limits of the workers or adhesives when necessary.
6. When using adhesives outside ambient air temperature shall be above 40 degrees F (4.4 degrees C) and rising. Curing or drying time of the adhesive will be affected by ambient temperatures and must be taken into consideration.
7. Humidity can affect the drying time of solvent borne adhesives or cause condensation to form on the newly applied adhesive.
8. No moisture may be present on the adhesives prior to mating or application of membranes.
9. Adhered membrane systems are to be broomed in place first and then completed by pressing the membrane into the adhesive with a weighted, foam covered lawn roller or 50 lb (22.7 kg) linoleum roller. Lawn rollers should be filled with between 6 and 8 gallons (22.7 and 30.3 L) of water.
10. Roofing systems shall only be installed over properly prepared and sound substrates, free from excessive surface roughness, dirt, debris and moisture.

C. Adhered Membrane:

1. The Authorized Applicator shall assume full responsibility for any and all irregularities, defects or quality issues that arise due to failure to following published "installation guidelines" for the proper installation of adhered membrane roofing systems.

2. FiberTite Membrane (Smooth-back) Adhered with Alpha-Tite Bonding Adhesive:
 - a. Position the FiberTite Membrane and fold the sheet back upon itself to allow a workable exposure of the underside of the sheet.
 - b. Apply a 100 percent continuous coat of bonding adhesive to the exposed bottom side of the membrane and a mirrored area of the substrate.
 - c. The amount of membrane and substrate that can be coated with adhesive will be determined by application method, ambient temperature, humidity and available manpower.
 - d. Adhesive is applied by rolling, using a 3/8-in (9.5 mm) nap roller.
 - e. Do not dump adhesive or pour from the cans.
 - f. Apply the adhesive to ensure a smooth, even 100 percent coverage of the substrate and membrane.
 - g. Roll the adhesive to ensure a smooth, even 100 percent coverage of the substrate and membrane with no voids, skips, globs, puddles or similar irregularities.
 - h. Adhesive coverage should average 100 square feet per gallon of applied adhesive with a 50 sq ft per gallon (1.23 sq m per L) net coverage, plus or minus 10 percent, for the membrane and substrate combined.
 - i. Allow the adhesive to flash off completely and become tacky.
 - j. Allow a 15-20 minutes flash time (at 70° F and 50% relative humidity). Using the finger-push method, check the adhesive by applying pressure with a finger, pushing across the adhesive. The adhesive is to be tacky, but not string or be liquid.
 - k. When the adhesive is sufficiently cured, carefully maneuver the glued portion of the membrane onto the glued substrate surface, avoiding any wrinkles or air pockets.
 - l. On vertical surfaces, broom the adhered portion of the membrane to ensure full contact and complete the bonding process by firmly pressing the bonded membrane into place using a clean paint roller.
 - m. On horizontal surfaces, broom the adhered portion of the membrane to ensure full contact and complete the bonding process by firmly pressing the bonded membrane into place with a weighted, foam-covered, lawn roller or 50 lb. (22.7 kg.) linoleum roller.
 - n. Repeat the process for the remaining unbonded portion of the membrane, lapping subsequent, adjacent rolls of membrane a minimum of 3 inches (76 mm), ensuring proper shingling of the membrane to shed water along the laps.
 - o. No adhesive shall be applied to the lap seam areas of the membrane. Areas contaminated with adhesive are difficult to clean, will impair proper welding of the seams and require a membrane patch or strip.
 - p. Do not use bad or marginal adhesives. Contact FiberTite Technical Services if the quality of the adhesive is suspect.
3. FiberTite Membrane (Smooth-back) Adhered with FTR-190e Bonding Adhesive:
 - a. Position the FiberTite Membrane and fold the sheet to allow a workable exposure of the underside of the sheet.
 - b. Apply a 100 percent continuous coat of bonding adhesive to the exposed bottom side of the membrane and a mirrored area of the substrate.
 - c. The amount of membrane and substrate that can be coated with adhesive will be determined by application method, ambient temperature, humidity and available manpower.
 - d. Adhesive may be applied by spraying and back rolling or just rolling. Do not dump adhesive or pour from the cans.
 - e. Roller applied adhesive shall utilize a solvent resistant 3/8 inch (9.5 mm) inch nap roller, spreading the adhesive to ensure a smooth, even 100 percent coverage of the substrate and membrane.
 - f. Spray applied adhesive must be spread out by roller to ensure a smooth, even 100 percent coverage of the substrate and membrane with no voids, skips, globs, puddles or similar irregularities.

- g. Adhesive coverage should average 100 square feet per gallon of applied adhesive with a 50 sq ft per gallon (1.23 sq m per L) net coverage, plus or minus 10 percent, for the membrane and substrate combined.
 - h. Allow the adhesive to dry or cure to a point of being tacky, but not stringy to the touch on both surfaces. Do not allow adhesive to completely dry out on either surface.
 - i. When sufficiently cured, carefully maneuver the glued portion of the membrane onto the glued substrate surface, avoiding any wrinkles or air pockets.
 - j. Broom the adhered portion of the membrane to ensure full contact and complete the bonding process by firmly pressing the bonded membrane into place with a weighted, foam-covered, lawn roller.
 - k. Repeat the process for the remaining unbonded portion of the membrane, lapping subsequent, adjacent rolls of membrane a minimum of 3 inches (76 mm), ensuring proper shingling of the membrane to shed water along the laps.
 - l. No adhesive shall be applied to the lap seam areas of the membrane. Areas contaminated with adhesive are difficult to clean, will impair proper welding of the seams and require a membrane patch or strip.
 - m. Do not use bad or marginal adhesives. Contact FTS if the quality of the adhesive is suspect.
- D. Peel Stops for Adhered Roofing Systems:
- 1. Seaman Corporation's standard Terms and Conditions for commercial warranties list 60 mph (96.6 kph) wind velocity as the first exclusion for wind events. Perimeter assurance or restraint must be provided for any modification to the standard commercial warranty.
 - 2. Assurance or restraint is accomplished using rows of fasteners, installed parallel to exterior roof edges at a prescribed interval and fastener spacing to create a peel stop during a significant wind event.
 - 3. Peel stops must be mechanically attached into or through the structural decking with rows of Magnum stress plates and fasteners, (or authorized alternate) at 12 inches (305 mm) on center. The peel stop is sealed by heat welding a nominal 6 inch strip of membrane over the fasteners.
 - 4. Lightweight insulating concrete is generally not considered a structural component and peel stop fastening must penetrate through the lightweight into the structural component.
 - 5. Peel Stops are only required by Seaman Corporation on adhered projects requiring peak gust wind speed warranties greater than the default 60 mph (96.6 kph) articulated in the standard commercial warranty.
 - 6. Although not required for standard commercial warranties, it is recommended that projects subject to the possibility of a significant wind event (hurricanes) should incorporate the use of peel stops in the roof system design.
 - 7. The following are "general" guidelines for the use and inclusion of peel stops in adhered FiberTite Roofing Systems. Peel stop intervals are based upon the field pressure and are as follows:
 - a. Design Velocity Pressure less than Minus 45 psf (2.154 kN per sq m), FM 1-90: No peel-stop.
 - b. Design Velocity Pressure greater than Minus 45 psf (2.154 kN per sq m), FM 1-90 but less than or equal to Minus 52.5 psf (2.514 kN per sq m), FM 1-105: One peel-stop at 18 inches (457 mm) from all edges.
 - c. Design Velocity Pressure greater than Minus 52.5 psf (2.514 kN per sq m), FM 1-105 but less than or equal to Minus 60 psf (2.873 kN per sq m), FM 1-120: One peel-stop at 18 inches (457 mm) from edges and the second peel stop at 3 feet (914 mm) from edges.
 - d. Design Velocity Pressure greater than minus 60 psf (2.873 kN per sq m), FM 1-120 but less than or equal to Minus 67.5 psf (3.232 kN per sq m), FM 1-135. One peel-stop at 18 inches (457 mm) from edges and the second peel stop at 3 feet (914) from edges and the third peel stop at 6 feet (1829 mm) from edges.

- e. Buildings with Non-Class 1 decking (i.e. lightweight, wood, gypsum, and cementitious wood fiber) do not default to the above requirements and require additional evaluation and engineering review by FTCS.

E. Welding:

1. General:

- a. Field seams exceeding 10 ft (9.3 m) in length shall be welded with an approved automatic welder.
- b. Field seams must be clean and dry prior to initiating any field welding.
- c. Remove foreign materials from the seams (dirt, oils, etc.) with Acetone or authorized alternative.
- d. Use clean white cotton cloths and allow approximately five minutes for solvents to dissipate before initiating the automatic welder. Do not use denim or synthetic rags for cleaning.
- e. Welding shall be performed only by qualified personnel to ensure the quality and continuity of the weld.
- f. Contaminated areas within a seam will inhibit proper welding and will require a membrane patch or strip.

2. Hot Air Hand Welding:

- a. The lap or seam area of the membrane may be intermittently tack welded to hold the membrane in place.
- b. The back, interior edge of the membrane shall be welded first, with a thin, continuous weld to concentrate heat along the exterior edge of the lap during the final welding pass.
- c. The nozzle of the handheld hot air welder shall be inserted into the lap at a 45-degree angle to the lap. Once the polymer on the material begins to flow, a hand roller shall be used to apply pressure at a right angle to the tip of the hand welder. Properly welded seams shall utilize a 1.5 inch (38 mm) wide nozzle, to create a homogeneous weld, a minimum of 1.5 inch (38 mm) in width.
- d. Smaller nozzles may be used for corners, and other field detailing, maintaining a minimum 1 inch (25 mm) weld.

3. Automatic Hot Air Machine Welding:

- a. Proper welding of the FiberTite Membrane can be achieved with a variety of automatic welding equipment.
- b. Follow all manufacturers' instructions for the safe operation of the automatic welder.
- c. Follow local code requirements for electric supply, grounding and surge protection.
- d. The use of a dedicated, portable generator is highly recommended to ensure a consistent electrical supply, without fluctuations that can interfere with weld consistency.
- e. Properly welded seams shall utilize a 1.5 inch (38 mm) wide nozzle, to create a homogeneous weld, a minimum of 1.5 inch (38 mm) in width.

F. Inspection:

- 1. The job foreman or supervisor shall initiate daily inspections of all completed work which shall include, but is not limited to, the probing of all field welding with a dull pointed instrument to assure the quality of the application and ensure that any equipment or operator deficiencies are immediately resolved.
- 2. Ensure all aspects of installation (sheet layout, attachment, welding, flashing details, etc.) are in strict accordance with the most current FiberTite Roofing Systems Specifications and Details.
- 3. Excessive patching of field seams because of inexperienced or poor workmanship will not be accepted at time of Final Inspection for Warranty Acceptance.
- 4. Any deviation from pre-approved specifications or details requires written authorization from the FTS prior to application to avoid any warranty disqualification.

5. It is the Applicator, job foreman, supervisor, or quality control personnel's responsibility to perform a final self-inspection on all seams prior to requesting the inspection for warranty issuance by the FTS.

G. T-Joint Cover Installation:

1. Installation of T-Joint Covers is mandatory on FiberTite Membrane Systems nominal 50 mil (1.3 mm) or greater, vegetated roofs, ballast roofs or where T-Joints have not been properly sealed to exhibit a minimum 1.5 inch (38 mm) defined crease along the T-Joint.
2. Install T-Joint Covers, centered and aligned so edges are parallel to roof system seams.
3. The T-Joint Cover shall be 100 percent welded.

3.9 FLASHING

- A. Clean vents, pipes, conduits, tubes, walls, and stacks to bare metal. Protrusions must be properly secured to roof deck with approved fasteners. Remove and discard lead, pipes and drain flashing. Flash penetrations according to approved details.
- B. Remove loose or deteriorated cant strips and flashings.
- C. Flash curbs, parapets and interior walls in strict accordance with approved FiberTite details.
- D. All flashing shall be adhered to properly prepared, approved substrates with Alpha-Tite bonding adhesive. FTR-190e bonding adhesive, or FTR-201 mastic applied in sufficient quantity to ensure total adhesion.
- E. The base flange of all membrane flashing shall extend out on to the plane of the deck, beyond the wood nailers to a maximum width of 8 inches (203 mm).
- F. Vertical flashing shall be terminated no less than 8 inches (203 mm) above the plane of the deck with approved termination bar and counter-flashing or metal cap flashing.
- G. When using FTR-201 as the adhesive, vertical wall flashing termination shall not exceed 40 inches (1016 mm) without supplemental mechanical attachment of the flashing between the deck and the termination point of the flashing.
- H. Complete all inside and outside corner flashing details with FiberTite preformed corners or an approved field fabrication detail.
- I. Probe all seams with a dull, pointed probe to ensure the weld has created a homogeneous bond.
- J. Install penetration accessories in strict accordance with approved details. Ensure penetration accessories have not impeded in any way the working specification. Refer to the related trade for the technical specification.

3.10 METAL FLASHING

- A. All perimeter edge details are to be fabricated from FiberClad Metal or utilize a prefabricated FiberTite Fascia System.
- B. Ensure all fascia extend a minimum of 2 inches (51 mm) lower than the bottom of the wood nailers.
- C. Fasten all metal flashing to wood nailers or approved substrate with approved fasteners 8 inches on center.
- D. Solidly weld FiberClad expansion joints with a 6-inch (152 mm) strip of FiberTite membrane welded to the Fiber Clad, covering the bond breaker tape (cover plates are optional).

- E. Roof Drains:
 - 1. Flash all roof drains in accordance with FiberTite roof drain details.
 - 2. Replace all worn or broken parts that may cut the FiberTite membrane or prevent a watertight seal. This includes the clamping ring and strainer basket.
 - 3. Replace all drain bolts or clamps used to hold the drain compression ring to the drain bowl.
 - 4. FiberTite non-reinforced 60 mil (1.52 mm) membrane shall be used for flashing the drain assembly. Drain assemblies and basins or sumps must be free of any asphalt or coal tar pitch residue prior to installation.
 - 5. The drain target sheet should be sized and installed to provide for a minimum of 12 inches (203 mm) of exposed 60 mil (1.52 mm) on all sides of the drain.

- F. Forti-Lock Liquid Flashing
 - 1. For aberrant penetrations and pitch pan avoidance, follow FiberTite Forti-Lock guidelines and details for substrate preparation and installation of Forti-Lock liquid flashing on pre-authorized aberrant penetrations.
 - a. Proper mechanical restraint is required for the roof membrane around the penetration prior to the installation of the Forti-Lock Liquid Flashing.
 - b. Forti-Lock Metal Primer: is required for all metal tie-ins and applications with high mechanical stresses, on detail work with small contact areas, metal components with large linear thermal expansion or edge metal terminations.

- G. Pitch Pans:
 - 1. Every reasonable effort shall be made to eliminate the need for pitch pans including the removal of existing pans. Contact FTS for specific design alternatives and recommendations.
 - 2. In the event of no alternative, fabricate pitch pans from FiberClad metal, installed in accordance with FiberTite details, ensuring proper attachment, maintaining a minimum of 2-inch (51 mm) clearance around the penetration.
 - 3. Pitch Pans shall be filled with non-shrinking grout to within 1 inch (25 mm) of the top of the pan. Allow the grout to dry and fill remainder of the pan with FTR-SLS pourable sealant.
 - 4. Pitch Pans and the sealant will require periodic maintenance by the building Owner's maintenance personnel.

3.11 EXPANSION JOINTS

- A. Flash all expansion joints in accordance with authorized details. Fasten all expansion joint material according to FiberTite specifications. Ensure the expansion material has sufficient material to expand to the widest point in expansion without causing undue stress on the expansion joint material.

- B. If the expansion joint is a preformed system, the manufacturer, description and a drawing illustrating the method of installation must be included when the project is registered.

3.12 SEALANTS

- A. Apply authorized sealants to all surface mounted reglets and per project requirements. Sealants are to shed water. Follow all manufacturer's instructions and installation guides.

- B. Use primer when recommended by the manufacturer.

- C. Sealants will require periodic maintenance by the building Owner's maintenance personnel.

3.13 TEMPORARY SEALS

- A. At the end of each working day or at the sign of rain, install temporary, 100 percent watertight seals where the completed new roofing adjoins the uncovered deck or existing roof surface.

- B. The Authorized Applicator shall create and maintain the temporary seal in such a manner to prevent water from traveling beneath the new or existing roof system.
- C. The use of plastic roofing cement is permissible when sealing to an existing built up roof.
- D. If water is allowed to enter beneath the newly completed roofing, the affected areas shall be removed and replaced at no additional expense to the building Owner.
- E. Prior to the commencement of work, cut out and remove all contaminated membrane, insulation, roof cement or sealant and properly dispose of offsite.

3.14 WALKWAYS

- A. FiberTite walkways and protection pads shall be installed at staging areas for rooftop equipment maintenance or areas subject to regular foot traffic.
- B. Walkway Installation:
 - 1. Roofing membrane to receive walkway material shall be clean and dry.
 - 2. Cut and position the FiberTite walkway material as directed by the specifications or agreement.
 - 3. Hot air weld the entire perimeter of the walk way to the previously cleaned FiberTite roofing membrane. Avoid excessive heating of the walk way material to prevent scorching the underlying roofing membrane.
- C. Protection Pad Installation:
 - 1. Roofing membrane to receive protection pad material shall be clean and dry.
 - 2. Prior to installing the FiberTite protection pads, 0.25 x 24 x 48-inch (6 x 610 x 1219 mm), weld a 6 x 6-inch (152 x 152 mm) strip of FiberTite membrane to each of the four corners of the back side of the pad. Position the strips in such a way that they overhang the edge of the pad a minimum of 2 inches (51 mm) around the 90-degree corner.
 - 3. Position the FiberTite protection pads as directed by the specifications or agreement and weld the visible portion of the previously applied stripping to the FiberTite roofing membrane.

3.15 LIGHTNING PROTECTION

- A. The installation of lightning protection must be coordinated with the Authorized Applicator, certified lightning contractor and the building Owner.
- B. The lightning protection must be installed in such a manner that base plates, air terminals and cables do not penetrate the roofing membrane without the use of pre-approved flashing details.
- C. Cables and air terminals may be attached to the membrane using base plates and FTR-101 sealant.
- D. Recommendations regarding the selection of adhesives or alternative affixing of lightning protection systems to the FiberTite membrane does not in any way imply a warranty covering their performance or ability of the adhesives to remain affixed to the FiberTite membrane.

3.16 COMPLETION

- A. Remove any and all debris, excess materials and scrap of any kind from the roof and surrounding premises prior to demobilization.
- B. Inspect all field welds, detailing and terminations to ensure a 100 percent the watertight installation.

3.17 FINAL INSPECTION FOR WARRANTY

- A. Upon completion of the project, the Authorized Applicator shall register the completion of the project with FiberTite Technical Services.
- B. Upon notice of completion, an FTS representative will schedule an inspection with a representative of the Authorized Applicator to thoroughly review the installation and verify compliance with Seaman Corporation specifications.
- C. Any corrections or modifications necessary for compliance with the specifications and acceptance for warranty (punch list) will be noted on the Final Inspection for Warranty Form.
- D. Upon completion of all punch list items and final acceptance of the installation, a warranty as authorized by the approved Seaman Corporation/FiberTite Project Registration will be issued.

END OF SECTION 000000

SECTION 07 62 00 – SHEET METAL FLASHING AND TRIM

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes:
 - 1. Roof drainage sheet metal fabrications.
 - 2. Low-slope roof sheet metal fabrications.
 - 3. Manufactured reglets and counterflashings.
 - 4. Miscellaneous sheet metal flashing and trim.
- B. Related Requirements:
 - 2. Division 06 Section " Rough Carpentry" for wood nailers, curbs, and blocking.
 - 3. Division 07 Section " 07 54 16" for warranty requirements for sheet metal flashing and trim items integral with roofing.

1.3 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leak proof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site in coordination with roofing Preinstallation conference.
 - 1. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

- B. Shop Drawings: For sheet metal flashing and trim.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include identification of material, thickness, weight, and finish for each item and location in Project.
 - 3. Indicate details meet requirements of SMACNA, NRCA and FMG required by this Section.
- C. Samples for Verification: For each type of exposed finish.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Contractor's Product Certificates: For each type of coping and roof edge flashing that is SPRI ES-1 tested.
- C. Product Test Reports: For each product, for tests performed by a qualified testing agency.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.
- B. Warranties: Manufacturer's executed warranty documents. Submit prior to acceptance of Work.

1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
 - 1. For copings and roof edge flashings that are SPRI ES-1 tested, shop shall be listed as able to fabricate required details as tested and approved.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.10 WARRANTY

- A. Refer to warranty requirements of Division 07 Section Ketone Ethylene Ester (KEE) Based Sheet Roofing for terms and conditions of warranties covering work of this Section.

- B. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Flashings and Fastening: Comply with requirements of Division 07 roofing sections. Provide base flashings, perimeter flashings, detail flashings and component materials and installation techniques that comply with requirements and recommendations of the following:
 - 1. FM Global 1-49: "Property Loss Prevention Data Sheet for Perimeter Flashings."
 - 2. FM Global 1-29: "Property Loss Prevention Data Sheet for Above Deck Roof Components."
 - 3. NRCA: "The NRCA Roofing Manual" for construction details and recommendations.
- D. SPRI Wind Design Standard: Manufacture and install roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressure:
 - 1. Design Pressure: As indicated on drawings.
- E. 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.

2.2 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 316, dead soft, fully annealed; with smooth, flat surface.
 - 1. Finish: 2D (dull, cold rolled).
- C. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet according to ASTM A 653/A 653M, G90 (Z275) coating designation; prepainted by coil-coating process to comply with ASTM A 755/A 755M.
 - 1. Surface: Smooth, flat.

2. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - b. Mica Fluoropolymer: AAMA 621. Two-coat fluoropolymer finish with suspended mica flakes containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
3. Color: As scheduled on Finish Schedule.
4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).

2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: Minimum 30 mils (0.76 mm) thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.
 1. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C) or lower.

2.4 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
 3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
 4. Fasteners for Zinc-Coated(Galvanized) and Aluminum-Zinc Alloy-Coated Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.
- C. Solder:
1. For Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
- E. Elastomeric Sealant: ASTM C 920, elastomeric polyurethanepolymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- G. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.
- H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.5 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 2. Obtain field measurements for accurate fit before shop fabrication.
 3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on

Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

- C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
 - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
 - 2. Use lapped expansion joints only where indicated on Drawings.
- D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.
- G. Seams, Soldered: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- H. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
- I. Do not use graphite pencils to mark metal surfaces.

2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

- A. Hanging Gutters: Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch- (2400-mm-) long sections. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard but with thickness not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.
 - 1. Expansion Joints: Butt type with cover plate.
- B. Built-in Gutters: Fabricate to cross section required, with riveted and soldered joints, complete with end pieces, outlet tubes, and other special accessories as required. Fabricate in minimum 96-inch- (2400-mm-) long sections. Fabricate expansion joints and accessories from same metal as gutters unless otherwise indicated.
 - 1. Fabricate gutters with built-in expansion joints.
 - 2. Fabricate from the Following Materials:
 - a. Prepainted, Metallic Coated Steel: 24 ga thick.

- C. Downspouts: Fabricate rectangular downspouts to dimensions indicated, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows.
 - 1. Fabricate from the Following Materials:
 - a. Prepainted, Metallic Coated Steel: 24 ga thick. Color as indicated on drawings.
 - 2. Provide downspout boot:
 - a. Prepainted, Metallic Coated Steel: 18 ga thick. Color as indicated on drawings.
- D. Splash Pans: Fabricate to dimensions and shape required and from the following materials:
 - 1. Aluminum: 0.040 inch (1.02 mm) thick.

2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof Edge Flashing and Fascia Cap: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long sections. Furnish with 6-inch- (150-mm-) wide, joint cover plates. Shop fabricate interior and exterior corners.
 - 1. Joint Style: Butted with expansion space and 6-inch- (150-mm-) wide, exposed cover plate.
 - 2. Fabricate from the Following Materials:
 - a. Prepainted, Metallic Coated Steel: 24ga thick.
- B. Thru-wall Reglet Flashing: Fabricate from the following materials;
 - 1. Stainless Steel: 24ga thick
- C. Copings: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, fasten and seal watertight.
 - 1. Joint Style: Butted with expansion space and 6-inch- (150-mm-) wide, exposed cover plate.
 - 2. Fabricate from the Following Materials:
 - a. Prepainted, Metallic Coated Steel: 24 ga thick.
- D. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
 - 1. Prepainted, Metallic Coated Steel; 24ga thick.
- E. Flashing Receivers: Fabricate from the following materials:

1. Stainless Steel: 24ga thick.
- F. Roof-Penetration Flashing: Fabricate from the following materials:
1. Stainless Steel: 24ga thick.
- G. Roof-Drain Flashing: Fabricate from the following materials:
1. Stainless Steel: 0.016 inch (0.40 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
1. Verify compliance with requirements for installation tolerances of substrates.
 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
 3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

- A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).
- B. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, according to manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.
- C. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps and edges with roller. Cover underlayment within 14 days.

3.3 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 3. Space cleats not more than 12 inches (300 mm) apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
 4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
 5. Torch cutting of sheet metal flashing and trim is not permitted.
 6. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
1. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches (600 mm) of corner or intersection.
1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
 2. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).

2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets with solder to width of 1-1/2 inches (38 mm); however, reduce pre-tinning where pre-tinned surface would show in completed Work.
1. Do not solder for aluminum sheet.
 2. Do not use torches for soldering.
 3. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
 4. Stainless-Steel Soldering: Tin edges of uncoated sheets, using solder for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.
- H. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

3.4 ROOF-DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.
- B. Hanging Gutters: Join sections with joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchor them in position. Provide end closures and seal watertight with sealant. Slope to downspouts.
1. Fasten gutter spacers to front and back of gutter.
 2. Anchor and loosely lock back edge of gutter to continuous cleat.
 3. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches (600 mm) apart.
 4. Anchor gutter with straps spaced not more than 24 inches (600 mm) apart to roof deck, unless otherwise indicated, and loosely lock to front gutter bead.
 5. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet (15.24 m) apart. Install expansion-joint caps.
- C. Downspouts: Join sections with 1-1/2-inch (38-mm) telescoping joints.
1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches (1500 mm) o.c.
 2. Provide elbows at base of downspout to direct water away from building.
 3. Connect downspouts to underground drainage system.

- D. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated. Lap joints minimum of 4 inches (100 mm) in direction of water flow.

3.5 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch (75-mm) centers.
- C. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.
- D. Copings: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated.
- E. Copings: Anchor to resist uplift and outward forces according to recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for specified FM Approvals' listing for required windstorm classification.
- F. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches (100 mm) over base flashing. Install stainless-steel draw band and tighten.
- G. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints minimum of 4 inches (100 mm). Secure in waterproof manner by means of anchor and washer at 36-inch (910-mm) centers unless otherwise indicated.

3.6 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Reglets: Installation of reglets is specified in Section 04 20 00 "Unit Masonry."

3.7 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.8 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.
- E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 62 00

SECTION 07 65 00 – FLEXIBLE FLASHING SELF-ADHERING

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

PART 1 GENERAL

1.01 SUMMARY

- A. Flexible stainless steel self-adhering flashing
- B. Related sections:
 - 1. 04 20 00 Unit Masonry
 - 2. 05 40 00 Cold Formed Metal Framing.
 - 4. 06 10 00 Rough Carpentry.
 - 6. 07 62 00 Sheet Metal Flashing and Trim.

1.02 REFERENCES

- A. Standards of the following as referenced:
 - 1. ASTM
 - 2. Brick Industry Association (BIA)
- B. Industry standards:
 - 1. BIA Technical Notes on Brick Construction No. 7, Water Penetration Resistance- Design and Detailing, August 2005.
 - 2. BIA Technical Notes on Brick Construction No. 28B, Brick Veneer/Steel Stud Walls, August 2005.

1.03 DEFINITIONS

- A. Terms:
 - 1. Cavity wall flashing: Same as flexible flashing.
 - 2. Foundation sill flashing: Same as flexible flashing.
 - 3. Flexible flashing: Water-proof material typically used in cavity wall construction to contain and assist in the proper water drainage that may penetrate wall system veneer. Other materials may be required to constitute the system.
 - 4. Head and sill flashing: Same as flexible flashing.
 - 5. Through-wall flashing:
 - a. Generally considered the same as flexible flashing.
 - b. Rare definition referred to full width cap flashing under copings or wall caps.

1.04 SUBMITTALS

- A. Product data: Indicate material type, composition, thickness, and installation procedures.
- B. Samples: 3" by 5" flashing material.
- C. Product Quality & Environmental submittals:
 - 1. Certificates:
 - a. Indicate materials supplied or installed are asbestos free.
 - b. Indicate recycled content: 60% total recycled material; based on 60% Post Industrial Recycled Content.

2. Performance Attributes
 - a. Tensile strength, >90,000 psi minimum, copper 32,000 psi average
 - b. Puncture Resistance, >2,500 pounds average, copper 450 psi average
 - c. When tested as manufactured, product resists growth of mold pursuant to test method ASTM D3273.
 - d. Certify the use of domestic manufactured stainless steel for flashing.
 - e. Certify products contain no silica or asbestos.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer: Provide flashing materials by single manufacturer with not less than twenty five years of experience in manufacturing flexible flashing products.
2. Flashing materials must be able to withstand 300° F temperature without changing the long term performance of the flashing.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. Flexible flashing:

1. Products of manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics, except as modified below, are acceptable for use, subject to compliance with specified requirements.
 - a. Product standard of quality:
 - 1). York Manufacturing, Inc.; York 316 SS
 - 2). STS Coatings, Inc.; Wall Guardian Self Adhering 316 Stainless Steel Flashing
 - 3). Vapro Shield, Inc.; VaproThru-Wall Flashing SA 316
 - 4). Other products that meet the criteria in section 1.04
2. Characteristics:
 - a. Type: stainless steel core with one stainless steel face (outward facing) with a butyl block co-polymer adhesive (inward facing).
 - b. Stainless steel: type 316, ASTM A240. Domestically sourced per DFARS 252.225-7008 and/or DFARS 252.225-7009.
 - c. Adhesive: block co-polymer
 - d. Size: Manufacturer's standard width rolls.

B. Accessories:

1. Polyether sealant:
 - a. York Manufacturing, Inc.; UniverSeal US-100
 - b. STS Coatings; GreatSeal LT-100
 - c. Prosoco, Inc.; R-Guard Joint Seam Sealer
2. Splice Tape:
 - a. York Manufacturing, Inc.; York 316 SS
3. Corner and End Dams: form the stainless steel flashing in the field or use 26 gauge stainless steel pre-manufactured corners.
4. Mortar deflection: polyester strands that will not degrade and will keep weep vents from clogging with mortar.
 - a. York Manufacturing; Weep-Armor or approved comparable product.
5. Termination bar: rigid PVC or stainless steel termination bar with sealant catch lip
 - a. York Manufacturing; T-96 termination bar

- b. York Manufacturing; SS Term Bar

PART 3 EXECUTION

3.01 INSTALLATION

A. General:

1. Install where indicated, specified, or required in accord with flashing manufacturer's written instructions and as follows.
2. Extend flashing 6" minimum beyond opening. Fold flashing ends at end of openings or horizontal flashing terminations to form end dam or use pre-manufactured units made of 26 gauge stainless steel.
3. Flashing width: Width required starting flush with outside face of exterior wythe, extending through cavity, rising height required to extend above lintel steel at least 2".
4. Splice end joints by overlapping them a minimum of 2" and seal with a compatible sealant or metal splice tape.
5. Masonry back up:
 - a. Surface apply after dampproofing installation specified in Damp proofing/Air Barrier Section in accord with manufacturer's installation instructions.
 - b. Fasten to masonry back-up surface at top by embedding in layer of sealant or use a non-corrosive termination bar and fasten it to the backer wall at the top edge of the flashing and seal the top edge with compatible sealant or use a termination clamp, which is embedded in the block back up wall.
6. Concrete back up:
 - a. Surface apply after damp proofing/air barrier installation specified in damp proofing Section in accord with manufacturer's installation instructions.
 - b. Fasten to concrete surface at top by embedding in layer of sealant or use a non-corrosive termination bar and fasten it to the backer wall at the top edge of the flashing and seal the top edge with a compatible sealant.
7. Stud back up with sheathing:
 - a. Fasten to stud back-up at top by embedding in layer of sealant or use a non-corrosive termination bar and fasten it to the backer wall at the top edge of the flashing and seal the top edge with a compatible sealant.
8. Leave ready for certified compatible building felt or air barrier installation lapping flashing top installed in another Section.
9. Fold ends of flashing at end of opening to form dam; seal with polyether sealant or use purchased manufacturers preformed end dams.
10. Inside and outside corners: Make in industry accepted manner using corner and splice material or purchase manufactured corners from manufacturer.
11. Use stainless steel or copper drip edge any location that the underside of the flashing will be exposed and/or deemed necessary by the design professional or AHJ on the project.
12. Cover flashing within a few days of installation to protect it from damage from the different trades, the environment and falling debris. If flashing is left unprotected and it is punctured, torn, or has loose scrim you should contact the manufacturer for repair instructions.

3.02 SCHEDULES

A. Locations:

1. Exterior door heads.
2. Window heads, jambs and sills.
3. Storefront heads.

4. Horizontal control joints.
5. Changes in veneer materials, vertically.
6. Other wall openings.
7. Other locations indicated on drawings.

END OF SECTION 07 65 00

SECTION 07 72 33 – ROOF HATCHES

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

SUMMARY

A. Work Included:

1. Provide factory-fabricated roof hatches for ladder access.

REFERENCES

A. ASTM International

1. ASTM A47 – Standard Specification for Ferritic Malleable Iron Castings.
2. ASTM A467 – Standard Specification for Machine and Coil Chain.
3. ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated or Zinc iron Alloy coated by the Hot-Dip Process.
4. ASTM A780 – Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

B. American Wood Protection Association:

1. AWPA U1 – use Category System: User Specification for Treated Wood.

C. National Roofing Contractors Association.

1. NRCA Waterproofing Manual.

D. Occupational Safety & Health Administration

1. OSHA Standard 19210.23 – Guarding floor and wall openings and holes.
2. OSHA Standard 1910.27 – Fixed ladders.

E. Sheet Metal and Air Conditioning Association

1. SMACNA Architectural Sheet Metal Manual, 5th addition, 1993.

F. Codes

1. 2021 International Building Codes.

SUBMITTALS

A. Product Data: Submit manufacturer's product data.

B. Shop Drawings: Show fabrication and installation details. Indicate dimensions, weights, loadings, required clearances, method of field assembly, accommodation for roofing profiles and components. Include plans, elevations, sections, details and attachments to other work.

C. Warranty: Submit executed copy of manufacturer's standard warranty.

QUALITY ASSURANCE

A. Manufacturer: A minimum of 5 years experience manufacturing similar products.

B. Installer: A minimum of 2 years experience installing similar products.

C. Manufacturer's Quality System: Registered to ISO 9001:2008 Quality Standards including in-house engineering for product design activities.

DELIVERY, STORAGE AND HANDLING

- A. Deliver products in manufacturer's original packaging. Store materials in a dry, protected, well-vented area. Inspect product upon receipt and report damaged material immediately to delivering carrier and note such damage on the carrier's freight bill of lading.

WARRANTY

- A. Manufacturer's Warranty: Provide manufacturer's standard warranty. Materials shall be free of defects in material and workmanship for a period of five years from the date of purchase. Should a part fail to function in normal use within this period, manufacturer shall furnish a new part at no charge.

PRODUCTS

- A. Basis-of-Design Manufacturer: Type S Roof Hatch by The Bilco Company, P.O. Box 1203, New Haven, CT 06505, 1-800-366-6530, Fax: 1-203-933-8478, Web: www.bilco.com.

ROOF HATCH

- A. Furnish and install where indicated on plans metal roof hatch Type S, size as indicated on drawings. Length denotes hinge side. The roof hatch shall be single leaf. The roof hatch shall be pre-assembled from the manufacturer.
- B. Performance characteristics:
Cover shall be reinforced to support a minimum live load of 40 psf (195kg/m²) with maximum deflection of 1/150th of the span or 20 psf (97 kg/m²) wind uplift. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing. Operation of the cover shall not be affected by temperature. Entire hatch shall be weather tight with fully welded corner joints on cover and curb. Units shall be Miami-Dade Product approved, NOA #11-0722.10 (Exp. 12/2/14) meeting large and small missile impact requirements. Florida Product Approval #FL15110.
- C. Cover: Shall be 11 gauge (2.3mm) aluminum with a 3" (76mm) beaded flange with formed reinforcing members. Cover shall have a heavy extruded EPDM rubber gasket that is bonded to the cover interior to assure a continuous seal when compressed to the top surface of the curb.
- D. Cover insulation: Shall be fiberglass of 1" (25mm) thickness, fully covered and protected by a metal liner 18 gauge (1mm) aluminum.
- E. Curb: Shall be 12" (305mm) in height and of 11 gauge (2.3mm) aluminum. The curb shall be formed with a 3-1/2" (89mm) flange with 7/16" (11.1mm) holes provided for securing to the roof deck. The curb shall be equipped with an integral metal capflashing of the same gauge and material as the curb, fully welded at the corners, that features the Bil-Clip® flashing system, including stamped tabs, 6" (153mm) on center, to be bent inward to hold single ply roofing membrane securely in place.
- F. Curb insulation: Shall be rigid, high-density fiberboard of 1" (25mm) thickness on outside of curb.
- G. Lifting mechanisms: Manufacturer shall provide compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and closing. The upper tube shall be the outer tube to prevent accumulation of

moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe for aluminum construction: welded to the curb assembly.

H. Hardware

1. Heavy pintle hinges shall be provided
2. Cover shall be equipped with a spring latch with interior and exterior turn handles
3. Roof hatch shall be equipped with interior and exterior padlock hasps.
4. The latch strike shall be a stamped component bolted to the curb assembly.
5. Cover shall automatically lock in the open position with a rigid hold open arm equipped with a 1" (25mm) diameter red vinyl grip handle to permit easy release for closing.
6. Compression spring tubes shall be an anti-corrosive composite material and all other hardware shall be Type 316 stainless steel hardware.
7. Cover hardware shall be bolted into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.

I. Finishes: Factory finish shall be mill finish aluminum.

EXAMINATION

- A. Examine substrates and openings for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

INSTALLATION

- A. Install products in strict accordance with manufacturer's instructions and approved submittals. Locate units level, plumb, and in proper alignment with adjacent work. Test units for proper function and adjust until proper operation is achieved. Repair finishes damaged during installation. Restore finishes so no evidence remains of corrective work.

ADJUSTING AND CLEANING

- A. Clean exposed surfaces using methods acceptable to the manufacturer which will not damage finish.

END OF SECTION 07 72 33

SECTION 07 84 00 – FIRESTOPPING

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

SECTION INCLUDES

- A. Non-combustible firestopping and fire safing materials, and accessories as shown on drawings, or if not shown, as required, including but not limited to the following:
 - 1. Intumescent Caulks, Elastomerics, Sealants, Compounds, Putties, Joint Sprays, Wrap Strips, and Coatings
 - 2. Silicone Sealants
 - 3. Mortar Materials (Cementitious)
 - 4. Firestopping Foam Materials
 - 5. Fire Block Materials
 - 6. Pillow Materials
 - 7. Mat Materials
 - 8. Cast-in-place Devices, Collars, and other materials, including fire/smoke stop systems, which meet the specified requirements.

- B. General description of the work in this section:
 - 1. Only tested firestop systems shall be used in specific locations as follows:
 - a. Penetrations for the passage of duct, cable, cable tray, conduit, piping, electrical busways and raceways through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies) and vertical service shaft walls and partitions.
 - b. Blank openings through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.
 - c. Openings and penetrations in fire-rated partitions or walls containing fire doors.
 - d. Openings around structural members which penetrate floors or walls.

RELATED WORK

- A. Section 03 30 00 - Cast-in-Place Concrete
- B. Section 04 20 00 - Masonry
- F. Section 09 21 16 - Gypsum Wallboard Systems: Wallboard used for fire rated construction.
- G. Division 23 - Mechanical: Requirements for penetrations through fire rated construction.
- H. Division 26 - Electrical: Requirements for penetrations through fire rate construction.

REFERENCES

- A. ASTM International (ASTM)
 - 1. C665, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
 - 2. E84, standard Test Method for Surface Burning Characteristics of Building Materials
 - 3. E119, Standard Test Methods for Fire Tests of Building Construction and Materials
 - 4. E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops
 - 5. E2174, Standard Practice for On-Site Inspection of Installed Fire Stops

- B. National Fire Protection Association (NFPA)
 - 1. 70, National Electric Code
 - 2. 101, Life Safety Code

- C. Underwriters Laboratories (UL)

1. 163, Fire Tests of Building Construction and Materials
2. 1479, Fire Test of Through-Penetration Firestops
3. 2079, Tests for Fire Resistance of Building Joint Systems
4. UL Fire Resistance Directory:
 - a. Firestop Devices (XHJI)
 - b. Fire Resistance Ratings (BXRH)
 - c. Through-Penetration Firestop Systems (XHEZ)
 - d. Fill, Voids, or Cavity Material (XHHW)
 - e. Forming Materials (XHKU)
 - f. Joint Systems (XHBN)

D. International Firestop Council Guidelines for Evaluation Firestop Systems Engineering Judgments

PERFORMANCE AND QUALITY ASSURANCE REQUIREMENTS

A. Firestopping Materials:

1. Shall be rated as non-combustible when tested in accordance with ASTM E119 to achieve fire rating noted on the drawings and provide a fire rating equal to that of construction being penetrated. If no such fire rating is noted on the drawings, the fire rating shall be required by the authorities having jurisdiction.
2. If such materials are used in a through-penetration seal condition, they shall be approved for such use, with all required devices and accessories forming an assembly or included in the test, when tested in accordance with ASTM E814 or UL 1479.
3. Tests shall be performed by an approved testing agency to indicate compliance with specified requirements and the resulting approval number shall be the latest or current test approved by authorities having jurisdiction. For those firestop applications that exist for which no UL tested system is available through a manufacturer, an engineering judgment derived from similar UL and approval prior to installation. Engineering judgment drawings must follow requirements set forth by the International Firestop Council.

B. Fire Safing Materials:

1. Shall be tested and rated non-combustible to achieve fire rating noted on the drawings, or if not noted, as required by authorities having jurisdiction.
2. If such materials are used in an assembly, they shall be approved for such use, with all required devices and accessories forming an assembly or included in the test.
3. Tests shall be performed by an approved testing agency to indicate compliance with specified requirements and the resulting approval number shall be the latest or current test approved by authorities having jurisdiction.
4. Proposed fire safing materials and methods shall conform to applicable governing codes having local jurisdiction.

C. Definitions: As they appear in this Section:

1. Combustible: Penetrations composed of any material which will burn or melt in a fire, including, but not limited to the following:
 - a. Nonmetallic pipes made of glass or plastic.
 - b. Metallic pipes made of lead or aluminum.
 - c. Electrical, data, communication, security, and telephone cables.
2. Non-combustible: Penetrations composed of material which will not burn or melt in a fire, including, but not limited to the following:
 - a. Metallic pipes made of steel, iron or copper.

3. Approved Testing Agencies: UL or other testing agency licensed and equipped to conduct the required fire tests and approved by authorities having jurisdiction.
 4. Authorities Having Jurisdiction: Shall be the person or entity responsible for applicable governing code enforcement.
- D. Manufacturer Qualifications: Those listed in Paragraph 2.1, A, or company specializing in manufacturing the products specified in this Section with minimum of five (5) years experience. Refer to Division 1 for substitutions.
- E. Installer Qualifications: Company specializing in performing the Work of this Section with minimum three (3) years experience installing tested and classified firestop and fire safing systems or manufacturer certification and approval.
- F. Standards: All firestop and fire safing systems shall have a flame (F) rating and temperature (T) rating conforming to applicable building codes and in accordance with Drawings and Specifications.
- G. Single Source Responsibility: Obtain firestopping and fire safing materials from a single manufacturer for each different product required.
- H. No firestopping or fire safing materials shall be concealed or covered until they have been observed and approved for use by the Architect and/or authorities having jurisdiction.

SUBMITTALS

- A. Product Data:
1. Manufacturer's technical data on product characteristics, performance, and limitation criteria for each material including UL firestop systems to be used.
 2. Manufacturer's installation instructions.
 3. Manufacturer's Material Data Sheets (MSDS)
- B. Shop Drawings: Manufacturer's shop drawings or detail sheets indicating each condition that requires a penetration or joint seal. Details must be in accordance with proposed approved system. Include materials to be used, anchorage, methods of installation and relationship to all adjacent construction.
- C. Manufacturer's engineering judgement identification number and drawing details when no UL system is available for application. Engineering judgment must include both project name and contractor's name who will install firestop system as described in drawing.
- D. Certifications:
1. Manufacturer's certification of compliance indicating approval of authorities having jurisdiction for combustibility and use of materials, and that their installation conforms to shown or required fire rating.
 2. Manufacturers affidavit that materials used in Project contain no asbestos.

DELIVERY, STORAGE AND HANDLING

- A. Deliver and store materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and UL label where applicable.

- B. Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.
- C. Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements, including temperature restrictions.
- D. Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.
- E. Do not use damaged or expired materials.

INSTALLER QUALIFICATIONS

- A. Engage an experienced installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an installer engaged by the Contractor does not in itself confer qualification on the buyer.

REGULATORY REQUIREMENTS

- A. Conform fire resistance ratings and surface burning characteristics of authorities having jurisdiction.
- B. Provide certificate of compliance from manufacturer indicating approval or authorities having jurisdiction for combustibility and use of materials, and that their installation conforms to shown or required fire rating.

ENVIRONMENTAL REQUIREMENTS

- A. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
- B. Weather conditions: Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.
- C. During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.
- D. Provide ventilation in areas to receive solvent cured materials.
- E. Sequence Work to permit firestopping and fire safing materials to be installed after adjacent and surrounding work is complete.

WARRANTY

- A. Warrant the work specified herein for two (2) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials and workmanship.

- B. Defects shall include, but not be limited to:
1. use of incorrect material within the installation
 2. No mineral wool insulation within a system that requires it.
 3. Use of mineral wool insulation when ceramic fiber insulation is required.
 4. Incorrect amount of material is installed within system.
 5. No use of an accessory seal within a system that requires one.
 6. Use of an incorrect system with a firestop or fire safing installation.
 7. Failure to meet specified performance or quality assurance requirements.

MANUFACTURERS/PRODUCTS

- A. Subject to compliance with through penetration firestop systems listed in Volume II of the UL Fire Resistance Directory (XHEZ), manufacturers specified are approved for use in the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 01.
1. Hilti, Inc.
 2. Nelson Firestop Products
 3. Specified Technologies, Inc.
 4. Tremco Inc.
 5. 3M Fire Protection Products
- B. To maintain clarity of products, specifications are based on specified products manufactured by Hilti, Inc.; Tulsa, OK. Listed manufacturers providing equivalent products are acceptable for use on this project.
- C. It is recognized that the manufacturers listed may not produce all of the specified types of products, therefore, products from several manufacturers may be used throughout the project as long as consistent use of each individual product is maintained throughout the project, they meet the requirements specified herein for the intended use, and are approved for that use by authorities having jurisdiction. Products which are combined to form a UL listed assembly must be provided as tested and approved as shown in the Fire Resistance Directory.

MATERIALS AND COMPONENTS

- A. General:
1. Any of the following materials, either by itself or in combination with other materials may be used on the Project provided they:
 - a. Satisfy the firestopping and fire safing requirements for use in the required application on the Project.]
 - b. Meet the performance and quality assurance requirements specified herein.
 - c. Are approved for use in that application by the authorities having jurisdiction.
 2. Materials shall comply with ASTM E814 (UL 1479) or ASTM E1119 (UL 263), and shall be manufactured of non-toxic, non-hazardous, asbestos free materials. Product shall bear proper independent test laboratory label/logo and shall conform to construction assembly type, penetrating item type, annular space requirements, and fire rating involved for each separate instance.
- B. Primers: Conform to firestop manufacturer's recommendations for primers required for various substrates and conditions.

- C. Back-Up (Damming) Materials: Conform to firestop manufacturer's recommendations for back-up (damming) materials. Material may be removable or permanent as recommended by manufacturer to suit application and as required by UL testing or other testing agency approved by authorities having jurisdiction.
- D. Retainers: Steel angles, clips, sheet metal, and impaling fasteners to support damming material and fire safing material and where required by UL testing or other testing agency approved by authorities having jurisdiction.
- E. Adhesives and Fasteners: Conform to firestop manufacturer's recommendations for adhesives and fasteners required for various substrates and conditions and to suit intended use. Materials must conform to those required by UL testing or other testing agency approved by authorities having jurisdiction.
- F. Firestopping Fill, Void, and Cavity Materials: Shall conform to those required by UL testing or other testing agency approved by authorities having jurisdiction, including, but not be limited to the following. Refer to list of approved manufacturers:
 - 1. Cast-in place firestop devices for use with combustible and non-combustible pipes (closed and open piping systems) and cable bundles penetrating concrete floors, the following products are acceptable:
 - a. "CP 680 Cast-In Place Firestop Device" manufactured by Hilti, Inc.
 - 1) Add Aerator adaptor when used in conjunction with aerator ("sovent") system.
 - b. "CP 681 Tub Box Kit" for use with tub installations manufactured by Hilti, Inc.
 - c. "CP 682 Cast-In Place Firestop Device" for use with noncombustible penetrants manufactured by Hilti, Inc.
 - 2. Sealants, caulking materials, or foams for use with non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT), the following products are acceptable:
 - a. "FS-ONE Intumescent Firestop Sealant" manufactured by Hilti, Inc.
 - b. "CP 604 Self-leveling Firestop Sealant" manufactured by Hilti, Inc.
 - c. "CP 620 Fire Foam" manufactured by Hilti, Inc.
 - d. "CP 606 Flexible Firestop Sealant" manufactured by Hilti, Inc.
 - e. "CP 601s Elastomeric Firestop Sealant" manufactured by Hilti, Inc.
 - 3. Sealants or caulking materials for use with sheet metal ducts, the following products are acceptable:
 - a. "CP 601s Elastomeric Firestop Sealant" manufactured by Hilti, Inc.
 - b. "CP 606 Flexible Firestop Sealant" manufactured by Hilti, Inc.
 - c. "FS-ONE Intumescent Firestop Sealant" manufactured by Hilti, Inc.
 - 4. Intumescent sealants, caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe, the following products are acceptable:
 - a. "FS-ONE Intumescent Firestop Sealant" manufactured by Hilti, Inc.
 - 5. Foams, Intumescent sealants, or caulking materials for use with flexible cable or cable bundles, the following products are acceptable:
 - a. "FS-ONE Intumescent Firestop Sealant" manufactured by Hilti, Inc.
 - b. "CP 620 Fire Foam" manufactured by Hilti, Inc.
 - c. "CP 601S Elastomeric Firestop Sealant" manufactured by Hilti, Inc.
 - d. "CP 606 Flexible Firestop Sealant" manufactured by Hilti, Inc.
 - 6. Non curing, re-penetrable, intumescent putty or foam materials for use with flexible cable or cable bundles, the following products are acceptable:
 - a. "CP 618 Firestop Putty Stick" manufactured by Hilti, Inc.

- b. "CP 658T Firestop Plug" manufactured by Hilti, Inc.
 7. Wall opening protective materials for use with U.L. listed metallic and specified nonmetallic outlet boxes, the following products are acceptable:
 - a. "CP 617 Firestop Putty Pad" manufactured by Hilti, Inc.
 8. Firestop collar or wrap devices attached to assembly around combustible plastic pipe (closed and open piping systems), the following products are acceptable:
 - a. "CP 643N Firestop Collar" manufactured by Hilti, Inc.
 - b. "CP 644 Firestop Collar" manufactured by Hilti, Inc.
 - c. "CP 645/648 Wrap Strips manufactured by Hilti, Inc.
 9. Materials used for large openings and complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:
 - a. "CP 637 Firestop Mortar" manufactured by Hilti, Inc.
 - b. "FS 657 FIRE BLOCK" manufactured by Hilti, Inc.
 - c. "CP 620 Fire Foam" manufactured by Hilti, Inc.
 - d. "CP 675T Firestop Board" manufactured by Hilti, Inc.
 10. Non curing, re-penetrable materials used for large openings and complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:
 - a. "FS 657 FIRE BLOCK" manufactured by Hilti, Inc.
 - b. "CP 675T Firestop Board" manufactured by Hilti, Inc.
 11. For blank openings made in fire-rated wall or floor assemblies, where future penetration of pipes, conduits, or cables is expected, the following products are acceptable:
 - a. "FS 657 FIRE BLOCK" manufactured by Hilti, Inc.
 - b. "CP 658T Firestop Plug" manufactured by Hilti, Inc.
- G. Fire Related Construction Joints and Other Gaps:
1. "CP 601S Elastomeric Firestop Sealant" manufactured by Hilti, Inc.
 2. "CP 606 Flexible Firestop Sealant" manufactured by Hilti, Inc.
 3. "CP 672 Firestop Joint Spray" manufactured by Hilti, Inc.
- H. Fire Safing Materials: Comply with ASTM C655, Type I, high-melt mineral fiber insulation with minimum nominal density of 4.0lbs per cubic foot, and having a maximum flame spread rating of 15 and smoke developed rating of 0. Size shall be 4 inches thick by 24 inches wide by 48 inches long, unless noted otherwise. Products containing asbestos strictly prohibited.
1. "Thermafiber Safing Insulation" manufactured by Thermafiber, Inc.
 2. "Fibrex Safing Insulation" manufactured by Fibrex Insulations, Inc.
 3. "Delta Safing Board" manufactured by Rock Wool Manufacturing Company.
- I. Jacketing (For use with fire protection board): 0.016 inch aluminum or 0.010 inch stainless steel roll jacketing as shown, or if not shown, as required where high traffic requires high durability and good appearance, and as directed by Architect.

EXAMINATION

- A. Examine joints and openings indicated or required to receive firestop and fire safing materials, for compliance with requirements for proper configuration, installation tolerances and other conditions affecting firestop and fire safing performance.
- B. Do not proceed with installation until unsatisfactory conditions are corrected.

- C. Beginning installation shall indicate acceptance of existing conditions. Work found to be defective or deficient due to uncorrected existing conditions prior to installation should be repaired or replaced at no additional expense to Owner.

PREPARATION

- A. Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
1. Verify penetrations are properly sized and in suitable condition for application of materials.
 2. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substance that may affect proper adhesion.
 3. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
 4. Install back-up (damming) materials to arrest liquid material leakage.
 5. Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.

COORDINATION

- A. Coordinate location and proper selection of cast-in-place Firestop Devices with trade responsible for the work. Ensure device is installed before placement of concrete.
- B. Responsible trades to provide adequate spacing for field run pipes to allow for installation of cast-in-place firestop devices without interferences.

INSTALLATION

- A. General:
1. Install firestop and fire safing materials in accordance with manufacturer's recommendations to provide F and T ratings as required by authorities having jurisdiction.
 2. Install firestop materials in accordance with UL Fire Resistance Directory.
 3. Install firestop and fire safing materials with sufficient pressure to properly fill and seal openings, then tool or trowel exposed surfaces.
- B. Firestopping Materials:
1. Install primer and firestopping material in sufficient thickness, with required accessories to achieve rating, to uniform density and texture, in accordance with manufacturer's instructions and authorities having jurisdiction.
 2. Install material at walls or partition openings which contain penetrating sleeves, piping, ductwork, conduit and other items requiring firestopping.
 3. Consult with mechanical engineer, and damper manufacturer prior to installation of UL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
 4. Remove dam material after firestopping material has cured or allow dam material to remain if required to maintain fire rating integrity or required by authorities having jurisdiction.
 5. Do not conceal or enclose any firestopping materials until they have been examined and approved use by the Architect and authorities having jurisdiction.
- C. Fire Safing Materials:

1. Install fire safing in sufficient thickness, with retainer materials where shown or required to achieve fire rating in accordance with manufacturer's instructions and authorities having jurisdiction.
 2. Do not conceal or enclose any fire safing materials until they have been examined and approved for use by the Archtiect and authorities having jurisdiction.
- D. Fire Protection Board Materials:
1. Install fire protection board in proper type, size, and density, with adhesives, fasteners, and jacketing materials where shown or required to achieve fire rating in accordance with manufacturer's instructions and authorities havning jurisdiction.
 2. Do not conceal or enclose any fire protection board materials unilt they have been examined and approved for use by the Architect and authorities having jurisdiction.

PROTECTION

- A. Protect adjacent surfaces from damage by material installation.

CLEANING

- A. Remove equipment, materials and debris, leaving area in undamaged, clean condition.
- B. Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials.

QUALITY CONTROL

- A. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
- B. Keep areas of work accessible until inspection by applicable coade authorities.
- C. Inspection of through-penetration firestopping shall be performed in accordance with ASTM E 2174, "Standard Practice for On-Site Inspetion of Installed Fire Stops".
- D. Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

END OF SECTION 07 84 00

SECTION 07 90 00 – JOINT SEALANTS

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

SCOPE

- A. Examine the drawings and all sections of the specifications to determine the extent of work required under this section.
- B. Additional caulking work is specified separately under Section 02 - Site Work Concrete.

REFERENCES

- A. ASTM International:
 - 1. ASTM C661 – Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer.
 - 2. ASTM C794 – Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.
 - 3. ASTM C834 – Standard Specification for Latex Sealants.
 - 4. ASTM C919 – Standard Practice for Use of Sealants in Acoustical Applications.
 - 5. ASTM C920 – Standard Specification for Elastomeric Joint Sealants.
 - 6. ASTM C1193 – Standard Guide for Use of Joint Sealants.
 - 7. ASTM D1056 – Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
 - 8. ASTM D1667 – Standard Specification for Flexible Cellular Materials-Vinyl Chloride Polymers and Copolymers (Closed-Cell Foam).
 - 9. ASTM D2240 – Standard Test Method for Rubber Property – Durometer Hardness.
 - 10. ASTM D2628 – Standard Specification for Performed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.
- B. South Coast Air Quality Management District:
 - 1. SCAQMD Rule 1168 – Adhesive and Sealant Applications.
- C. Codes
 - 1. 2018 International Building Codes.

SUBMITTALS

- A. Products Data: Submit data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and color availability.
- B. Samples: Submit two samples illustrating sealant colors for selection.
- C. Manufacturer's installation instructions: Submit special procedures, surface preparation, and perimeter conditions requiring special attention.
- D. Certification from sealant manufactureres that their products are suitable for the use indicated and comply with Specifications requirements.
- E. Report from sealant applicator summarizing results of preconstruction field adhesion testing.
- F. Warranty: Include coverage for installed sealants and accessories failing to achieve airtight seal , watertight seal, exhibit loss of adhesion or cohesion, and sealants which do not cure.

PRODUCTS

- A. Manufacturers:
1. Dow Corning Corp.
 2. GE Silicones
 3. Pecora Corp
 4. Sika Corp
 5. Tremco Sealants & Waterproofing
 6. BASF Building Systems

MATERIALS

EXTERIOR SEALANTS:

- A. General Purpose Exterior (Nontraffic) Sealant: Polyurethane; ASTM C920, Grade NS, Class 50, Uses M, G, A, and O; multi-component.
1. Type: Dymeric 240 manufactured by Tremco
 2. Color: Standard colors matching finished surfaces.
 3. Applications: Use for:
 - a. Control, expansion, and soffit joints in masonry.
 - b. Joints between concrete and other materials.
 - c. Joints between metal frames and other materials.
 - d. Exposed joints in metal copings, trim and flashings.
 - e. Other exterior nontraffic joints for which no other sealant is indicated.
- B. General Purpose Exterior Traffic Bearing Sealant: Polyurethane; ASTM C920, Grade P, Class 25, Use T: multi-component.
1. Type: THC 900/901 manufactured by Tremco; Use THC 901 for joints on slope greater than 5 percent.
 2. Color: Standard colors matching finished surfaces.
 3. Applications: Use for exterior pedestrian and vehicular traffic bearing joints.
- C. High Performance Silicone Sealant: Silicone; ASTM C920, Type S, Grade NS, Class 50, Uses NT, G, A, and O; single component.
1. Type: Spectrum 3 manufactured by Tremco.
 2. Color: Standard colors matching finished surfaces.
 3. Applications: Use for joints between panels of composite or fabricated aluminum panel systems.
- D. Exterior Foam Expansion Joint Sealer: Precompressed foam sealer, Polyurethane with water repellent, +/- 25 percent movement capability.
1. Color: Face color as selected.
 2. Size: As required to provide watertight and airtight seal when installed.
 3. Applications: Use for exterior wall expansion joints.
 4. Manufacturers:
 - a. Colorseal; Emseal Corp.
 - b. Polytite R or Polytite Standard; Dayton Superior
 - c. Illmod 600; Tremco
- E. Exterior Metal Lap Joint Sealant: Butyl or polyisobutylene, non drying, non-skinning, non-curing.

1. Type: Butyl Sealant manufactured by Tremco.
2. Applications: Use for concealed sealant bead in sheet metal work as concealed sealant bead in siding overlaps.

INTERIOR SEALANTS

- A. General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C831, single component, paintable.
1. Type: Tremflex 834 manufactured by Tremco.
 2. Color: Standard color matching finished surfaces.
 3. Applications: Use for interior wall and ceiling control joints, joints between door and window frames and wall surfaces, and other interior joints for which no other type of sealant is indicated. For interior control joints in brick, unpainted concrete masonry, cast stone, or stone, use General Purpose Exterior Sealant.
- B. General Purpose Interior Traffic Bearing Sealant: Polyurethane; ASTM C920, Grade NS, Class 25, Use T; single-component.
1. Type: Vulkem 116 manufactured by Tremco.
 2. Color: Standard colors matching finished surfaces.
 3. Applications: Use for interior pedestrian traffic bearing joints.
- C. Silicone Sealant: Silicone; ASTM C920, Uses G, A, and O; single component, mildew resistant.
1. Type: Tremsil 200 manufactured by Tremco.
 2. Applications: Use of joints between plumbing fixtures and floor and wall surfaces, joints between toilet room counter tops and wall surfaces, and tile control and perimeter joints in shower rooms and other wet areas.

ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
1. Interior Sealants and Sealant Primers: Maximum volatile organic compound content in accordance with SCAQMD Rule 1168.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer, compatible with joint forming materials.
- C. Joint Backing: Round foam rod compatible with sealant; ASTM D1056, sponge or expanded rubber; oversized 30 to 50 percent larger than joint width.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

APPLICATION

- A. Prepare joint surfaces, install backer rod and prime in strict accordance with the manufacturer's written instructions.
- B. Mix sealant, place in joint and tool finish in strict accordance with manufacturer's written instructions.
- C. Exercise special care in preparing and priming horizontal portions of joints to be sealed which are subject to incidental water immersion.

GUARANTEE

- A. Sealant installations shall be guaranteed for a period of two (2) years from the date of substantial completion against defects in materials and workmanship.

END OF SECTION 07 90 00

SECTION 08 11 00 – METAL DOORS AND FRAMES

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

GENERAL

A. Section includes:

1. Interior and Exterior Steel doors and frames, rated and non-rated.
2. Interior Steel frames for wood doors.
3. Interior Steel framed windows.
4. Interior Sound rated frames.

B. Related Requirements:

1. Division 01 Sections – General Provisions
2. Section 04 20 00 – Unit Masonry
3. Section 08 14 00 – Wood Doors
4. Section 08 71 00 – Finish Hardware
5. Section 08 80 00 – Glazing
6. Section 09 21 16 – Gypsum Board Assemblies
7. Section 09 90 00 – Painting

REFERENCE SPECIFICATIONS

A. Work under this section shall be governed by the following specifications, except as modified herein.

1. Specifications for Custom Hollow Metal Doors and Frames, HMMA 810, of the National Association of Architectural Metal, Manufacturers.
2. ANSI/DHI A 115 - Specifications for Hardware Preparations in Standard Steel Doors and Frames
3. ANSI/DHI A 115.IG - Installation Guide for Doors and Hardware
4. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows
5. ANSI/NFPA 252 - Standard Methods of Fire Tests of Door Assemblies
6. ANSI A250.6 – Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
7. ANSI A250.8 (SDI-100) – Recommended Specifications for Standard Steel Doors and Frames.
8. ANSI A250.10 – Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
9. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames
10. ANSI/UL 9, Fire Test of Window Assemblies
11. ANSI/UL 10B, Fire Tests of Door Assemblies
12. ANSI/UL 10C, Positive Pressure Fire Test of Door Assemblies
13. ANSI/UL 1784, Air Leakage Tests of Door Assemblies
14. ASTM A653/A 653 M, Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
15. ASTM A1011, Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High Strength Low-Alloy and High Strength Low-Alloy with Improved Formability
16. ASTM C143, Test Method for Slump of Hydraulic-Cement Concrete
17. ASTM C1363, Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus

18. ASTM E283, Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
19. ASTM E330, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
20. NAAMM HMMA 820 TN01-03, Grouting Hollow Metal Frames
21. NAAMM HMMA 840, Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames
22. NAAMM HMMA 850, Fire-Rated Hollow Metal Doors and Frames
23. SDI 111, Recommended Details and Guidelines for Standard Steel Doors and Frames and Accessories
24. SDI 112, Zinc-Coated (Galvanized/Galvannealed) Standard Steel Doors and Frames
25. SDI 117, Manufacturing Tolerances for Standard Steel Doors and Frames
26. SDI 118, Basic Fire Door Requirements

REGULATORY REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

SUBMITTALS

- A. General: Submit each item in the Article in accordance with Section 01 33 00.
- B. Product Data: For each type of frame, include details of construction, materials, dimensions, hardware preparation, core, label compliance, sound ratings, profile, installation instructions and finish.
- C. Shop Drawings: Show fabrication and installation of Steel Doors, Windows and Frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of door and frame hardware reinforcements and details of joints and connections. Show anchorage and accessory items.

COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate access control requirements with Section 08 71 00 Door Hardware.

MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.
 1. Ceco Door, An ASSA ABLOY Door Company
 2. Curries, Division of AADG Inc.
 3. DeanSteel Manufacturing Company, Inc.

4. Mesker Door, Inc.
5. Republic Doors and Frames
6. Steelcraft Mfg. Co. Ingersoll Rand Corp.

DOOR CONSTRUCTION

- A. Interior Doors: Interior doors: 1-3/4 inch thick doors with face sheets shall be 16 guage (0.059 in.) minimum thickness and shall be manufactured from cold-rolled steel conforming to ASTM A 1008/A 1008M, or hot-rolled, pickled and oiled (HRPO) steel conforming to ASTM A 1011/A 1011M CS Type B. Steel shall be free of scale, pitting, coil breaks or surface blemishes, buckles, waves or other defects.
1. For interior areas subject to moisture and high humidity (e.g. kitchen, service areas, locker rooms, showers, etc.) utilize zinc-coated face sheets..
 2. Sound-Rated Doors: Where shown or scheduled, provide sound control door assemblies tested by an independent testing agency per ASTM E90 with the specified minimum STC rating per ASTM E413 for the configuration indicated.
 - a. Acoustical performance shall meet manufacturer's published data for transmission loss based on door type specified.
 - b. Unless otherwise indicated, provide acoustical assemblies with STC sound ratings of 50 or better.
- B. Exterior Doors: 1 3/4" thick doors with face sheets shall be 16 guage (0.059 in.) minimum thickness steel.
1. Thermal Insulated Door: Total insulation U-Value rating of 0.067, R-Value of 14.97 or better measured in accordance with ASTM C1363.
- C. Construction:
1. Doors shall be the types, sizes, and construction, in accordance with the Contract Documents, and shall meet the performance requirements specified herein. Prior to shipment mark each door with an identification number as shown on approved submittal drawings.
 2. Door face sheets shall be joined at their vertical edges by a continuous weld extending the full height of the door with no visible seams on their faces or vertical edges.
 3. Minimum nominal door thickness shall be 1-3/4 in. Door shall be neat in appearance and free from warpage or buckle. Edge bends shall be true and straight and of minimum radius for the thickness of metal used.
 4. Doors shall be stiffened by continuous vertically formed steel sections which, upon assembly, shall span the full thickness of the interior space between door faces. These stiffeners shall be 0.026 in. minimum thickness, spaced so that the vertical interior webs shall be no more than 6 in. apart and securely fastened to both face sheets by spot welds spaced a maximum of 5 in. o. c. vertically. Spaces between stiffeners shall be filled with fiberglass or mineral rock wool batt-type material.
 5. The top and bottom edges shall be closed with a continuous steel channel, not less than .053 in. thickness, welded to both face sheets.
 6. Exterior doors, or where otherwise scheduled by the Architect, shall be closed flush at the top edge. Where required for attachment for weather-stripping, a flush steel closure channel shall also be provided at the bottom edge. Openings shall be provided in the bottom closure channel of exterior doors to permit the escape of entrapped moisture.
 7. Edge profiles shall be provided on both vertical edges of doors as follows, unless hardware dictates otherwise:
 - a. Single Acting Doors: Beveled 1/8 in. in 2 in. profile.
 - b. Double Acting Doors: Rounded on 2-1/8 in. radius.

8. Hardware Reinforcements and Preparations:
 - a. Doors shall be mortised, reinforced, drilled and tapped at the factory for templated hardware only, in accordance with the approved hardware schedule and templates provided by the hardware supplier. Where surface mounted hardware, anchor hinges, thrust pivots, pivot reinforced hinges, or non-templated hardware apply, doors shall be reinforced, with drilling and tapping done by others in the field.
 - b. Minimum steel thickness for hardware reinforcements shall be as follows:
 - 1) Full mortise hinges and pivots: 0.167 in.
 - 2) Lock fronts, strikes, concealed holders, or surface mounted closures: 0.093 in.
 - 3) Internal reinforcements for other surface applied hardware: 0.067 in.
 - c. In cases where electrically or electronically operated hardware is required, and indicated on the approved hardware schedule, conduit, hardware enclosures and/or junction boxes within the door shall be provided. Access plates, where required, shall be the same material and thickness as the door face sheets and shall be fastened with not less than four (4) #8-32 machine screws or #6 sheet metal screws at a spacing not to exceed 12 in. on center. Access plate screws shall be corrosion resistant.
9. Glazing Moldings and Stops:
 - a. Where specified or scheduled, doors shall be provided with steel moldings to secure glazing materials furnished and installed in the field by others, in accordance with glazing sizes and thickness shown in the contract documents.
 - b. Fixed glass molding shall be welded to the secure side.
 - c. Removable glass stops shall be channel shaped, not less than 0.032 in. thickness, with tight fitting butt or mitered corners, and secured with #6 minimum, corrosion resistant countersunk sheet metal screws.
 - d. Metal surfaces to which glazing stops are applied, and the inside of the glazing stops shall be treated for maximum paint adhesion and painted with a rust inhibitive primer prior to installation in the door. Glazing stops fabricated from zinc-coated steel conforming to ASTM A 653/A 653M, A40 (ZF120) for interior doors, A60 (ZF180) or G60 (Z180) for exterior openings need not be primed on the inside.
 - e. Fire rated doors shall be prepared for listed glazing as required in accordance with the door manufacturer's fire rating procedure. Accessories:

FRAMES

- A. Interior Frame Product: Profiles shall be 0.053 in. minimum thickness. Frame product shall be 0.067 in. minimum thickness for single door openings exceeding 4 ft. in width, and pairs with either door exceeding 4ft. in width.
 1. For interior areas subject to moisture and high humidity (e.g. kitchen, service areas, locker rooms, showers, etc.) utilize zinc-coated frame product as specified under Exterior Frame Product.
- B. Exterior Frame Product: Frame product shall be manufactured from zinc coated steel conforming to ASTM A 653/A 653M CS Type B, Coating Designation A60 (ZF180) or G60 (Z180). Profiles product shall be 0.067 in. minimum thickness.
- C. Construction:
 1. Frame product shall have integral stops and be welded units of the sizes and types shown on approved submittal drawings. Frame product shall be constructed in accordance with the

- Contract Documents and meet the performance criteria specified in Section 1.05.B and 1.05 C. Knock down frames are not acceptable. Frame product shall be constructed in accordance with NAAMM HMMA 820 with regard to joint designs and welding techniques. Prior to shipment mark frame product with an identification number as shown on approved submittal drawings.
2. Finished work shall be neat in appearance, square, and free of defects, warps and buckles. Pressed steel members shall be straight and of uniform profile throughout their lengths.
 3. Jamb, header, mullion and sill profiles shall be in accordance with the frame schedule and as shown on the approved submittal drawings.
 4. Corner joints shall have all contact edges closed tight with faces mitered and stops either butted or mitered.
 - a. Welding:
 - 1) Perimeter face joints (flush or indented) shall be continuously welded internally or externally. Flush face joints shall be finished smooth with seamless faces. Rabbits and soffits shall be continuously welded internally. The use of gussets or splice plates as a substitute for welding shall not be acceptable.
 - 2) Internal flush face joints shall be continuously welded and finished smooth with seamless faces.
 - 3) Members at internal indented intersections shall be securely welded to concealed reinforcements, and have hairline face seams.
 - 4) All other intersection elements shall have hairline seams.
 5. Minimum height of stops shall be 0.625 in.
 6. Each door opening shall be prepared for single stud, resilient door silencers, three (3) per strike jamb for single door openings, two (2) per head for pairs, except on gasketed or weather stripped frame product. Silencers shall be supplied and installed per hardware schedule.
 7. Hardware Reinforcements and Preparations
 - a. Frame product shall be mortised, reinforced, drilled and tapped at the factory for templated hardware only, in accordance with the approved hardware schedule and templates provided by the hardware supplier. Where surface mounted hardware, anchor hinges, thrust pivots, pivot reinforced hinges, or non-templated hardware apply, frame product shall be reinforced, with drilling and tapping done by others in the field.
 - 1) Full mortised hinges and pivots: 0.167 in. x 1.25 in. x 10 in. length
 - 2) Strikes: 0.093 in. or 0.053 in. unitized reinforcement with extruded tapped holes that provide equivalent number of threads as 0.093 in.
 - 3) Flush bolts, closers, hold open arms, and other surface applied hardware: 0.093 in.
 8. In cases where electrically or electronically operated hardware is required, and indicated on the approved hardware schedule, conduit, hardware enclosures and/or junction boxes shall be provided. Access plates, where required, shall be the same material and thickness as the frame product and shall be fastened with not less than four (4) #8-32 machine screws or #6 sheet metal screws at a spacing not to exceed 12 in. on center.
 9. Floor Anchors:
 - a. Floor anchors shall be provided with two holes for fasteners and shall be secured inside jambs with at least four (4) spot welds per anchor.
 - b. Where specified or scheduled, adjustable floor anchors, providing not less than 2 in. height adjustment, shall be fastened in place with at least four (4) spot welds per anchor.
 - c. For applications that do not permit the use of a floor anchor, an additional jamb anchor shall be substituted at a location not to exceed 8 in. from the base of the jamb.
 - d. Floor anchor shall be of same material and thickness as frame.
 10. Jamb Anchors:

- a. Frame product shall be provided with anchorage appropriate to frame and wall construction.
 - b. Masonry Type:
 - 1) Frame product for installation in new masonry walls shall be provided with steel adjustable jamb anchors of the strap and stirrup or T-strap type not less than 0.053 in. thickness, or wire type not less than 0.156 in. in diameter. Straps shall be not less than 2 in. x 10 in. in size, corrugated and/or perforated. Jamb anchors shall be placed at a maximum of 18 in. from top and bottom of openings. The minimum number of anchors spaced at maximum 32 in. on center, provided on each jamb, based on the over-all frame height, shall be as follows:
 - a. Up to 60 in.: 2 anchors
 - b. Greater than 60 in. up to 90 in.: 3 anchors
 - c. Greater than 90 in. up to 96 in.: 4 anchors
 - d. Greater than 96 in.: 4 anchors plus one for each 24 in. or fraction thereof, spaced at 24 in. maximum between anchors.
 - c. Dry Wall Type:
 - 1) Frame product for installation in dry-wall partitions shall be provided with steel jamb anchors of suitable design, not less than 0.042 in. thickness, securely welded inside each jamb. Jamb anchors shall be placed a maximum of 18 in. from top and bottom of openings. The minimum number spaced at maximum 32 in. on center, provided on each jamb, based on the over-all frame height, shall be as follows:
 - a. Up to 60 in.: 3 anchors
 - b. Greater than 60 in. up to 90 in.: 4 anchors
 - c. Greater than 90 in. up to 96 in.: 5 anchors
 - d. Greater than 96 in.: 5 anchors plus one for each 24 in. or fraction thereof, spaced at 24 in. maximum between anchors.
 - d. Expansion Bolt Type:
 - 1) Frame product for installation in existing masonry or concrete walls shall be prepared for expansion bolt type anchors. The preparation shall consist of a countersunk hole for a 0.375 in. diameter flat head bolt and a spacer within the frame profile. The spacer shall be welded to the frame and spaced a maximum of 6 in. from the top and bottom of the frame, with intermediate spacing at a maximum of 26 in. on center. Bolts and shields for such anchors shall be provided and installed by others.
 - e. Other Anchor Types:
 - 1) Frame product to be installed in pre-finished concrete, masonry or steel openings, shall be constructed and provided with anchoring systems of suitable design and quantity as shown on the approved submittal drawings. Fasteners for such anchors shall be provided and installed by others.
11. Frame product for installation in masonry walls with door openings greater than 48 in. in width shall have a steel angle or channel stiffener factory welded into the head, when the head is to be grouted. Such stiffeners shall be not less than 0.093 in. in thickness, not longer than the door opening width, and shall not be used as lintels or load bearing members.
 12. Grout guards fabricated from not less than 0.016 in. thick steel shall be provided at hardware mortises on frame product to be grouted.
 13. All door openings in frame product shall be provided with a temporary steel spreader welded to the feet of the jambs or mullions to serve as bracing during shipping, and handling, and which shall not be used for installation.
 14. Removable Glazing Stops:
 - a. Where specified, frame product shall be provided with removable stops to secure glazing material or in-fill panels. Glazing materials shall be furnished and installed in the field by others, in accordance with glazing sizes and thickness shown in the Contract Documents.

- b. Removable steel channel glazing stops shall be not less than 0.032 in. thick, butted at corners and secured to the frame section using #6 minimum, corrosion resistant countersunk sheet metal screws.
- c. The frame section underneath the glazing stops and the inside of the glazing stops shall be treated for maximum paint adhesion and painted with a rust inhibitive primer prior to installation in the opening. Glazing stops fabricated from zinc-coated steel conforming to ASTM A 653/A 653M, A40 (ZF120) for interior frames, A60 (ZF180) or G60 (Z180) for exterior openings need not be primed on the inside.

FINISHES

- A. Interior frames shall be factory primed, then field painted as specified in Division 09 90 00 of these specifications.
- B. Exterior frames shall be factory galvanized, type G-60, and primed, then field painted as specified in Division 09 90 00 of these specifications.

HARDWARE

- A. Mortise and reinforce for all hardware.
- B. Refer to Finish Hardware Division 08 71 00 for templating and hardware types.

INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or as required by standards specified.
 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-rated openings, install frames according to NFPA 80.
 - b. Install frames with removable stops located on secure side of opening.
 - c. Install door silencers in frames before grouting.
 - d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - e. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
 5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
 6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

7. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
 8. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Steel Doors:
 - a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
 - c. At Bottom of Door: 5/8 inch to 3/4 inch plus or minus 1/32 inch.
 - d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.
 2. Doors with Thresholds: As required to suit threshold.
 3. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
- D. Glazing: Comply with installation requirements in Section 08 80 00 "Glazing" and with hollow-metal manufacturer's written instructions.
1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 08 11 00

SECTION 08 14 00 – WOOD DOORS

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

REFERENCE SPECIFICATIONS

- A. Work under this section shall be governed by the current editions of the following standards and specifications to the extent that they are applicable:
1. NWWDA 1.5-1; AWI Sections 1300-5, 1300SLC-5 and 1300FD; ASTM E-152; NFPA 252; UL 10B and NFPA 80.

SHOP DRAWINGS

- A. Comply with Section 01 33 00 - Submittal Procedures.
- B. Provide shop drawings which include schedule of all doors to be provided as well as details and/or literature describing door construction, AWI grade and veneer type, cut and grade.

WARRANTY

- A. All wood doors and/or transom panels shall have a 1 year warranty against becoming unserviceable or objectionable in appearance as a result of being defective or non-conforming. Without limiting the scope of the warranty the doors provided shall be guaranteed not to:
1. Warp in excess of 1/4" as defined by NWWDA.
 2. Warp or twist to a degree that the door will not operate properly.
 3. Photograph any show-through of stiles, rails or cores.

DOOR CONSTRUCTION

- A. Construction types:
1. Wood blocks or staves. Plain, framed or bonded stile and rail.
 2. Chipboard, particle board.
 3. Edges to be solid hardwood.
 4. Wood veneer faces.
 5. Special cores as required for fire rated doors.
 6. Provide U.L. Label fire doors and transoms when and as scheduled on the drawings.
 7. Add wood blocking reinforcing for closer through bolts.
- B. Plies:
1. 5 ply , bonded core, construction.
 2. Hardwood crossbanding.
 3. Veneer Grade: Premium, Grade A,
 4. Wood Species: Birch WH / AF
 5. Cut: Plain Sliced
 6. Assembly: Balanced
- C. Glue:

1. Water-resistant, type II.

FACTORY FINISHING

- A. Doors shall receive factory finishing.
- B. WDMA System TR-6, catalyzed polyurethane, premium grade.
 1. Paint coat. Sherwin Williams color selected by Architect.
 2. Sealer: 3 coats
 3. Sanding: Sand
 4. Topcoat: 2 coats
- C. Top and Bottom Rails: Factory sealed.

DOOR LITE FRAMES

- A. Cold rolled steel, 18 gauge, fire rated and factory primed, model 84G as manufactured by Advantage Lites & Louvers, Inc., 415 Concord Avenue, Bronx, NY 10455. Tel: 718-585-3230. Fax: 718-292-2243
- B. Color to match "P2" as shown on material schedule on drawings.

DELIVERY

- A. Doors shall be individually wrapped or cartoned at the factory for protection during transit and storage periods, and shall be marked as per tag designations on shop drawings.

INSTALLATION

- A. Doors shall be sized and beveled for proper fit and security on the lock edge.
- B. Use template machine guides to prepare doors for hanging and installing hardware.

END OF SECTION 08 14 00

SECTION 08 31 00 – ACCESS DOORS AND FRAMES

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

GENERAL

- A. Section includes:
 - 1. Wall access doors.
 - 2. Ceiling access doors

RELATED REQUIREMENTS

- A. Section 04 20 00 – Unit Masonry
- B. Section 08 71 00 – Finish Hardware
- C. Section 09 21 16 - Gypsum Board Assemblies
- D. Section 09 90 00 - Paints and Coatings
- E. Division 16 - Electrical

SYSTEM DESCRIPTION

- A. Design Requirements:
 - 1. Verification: Obtain specific locations and sizes for required access doors and frames from trades including electrical, requiring access to concealed equipment and indicate on submittal schedule.

SUBMITTALS

- A. Shop Drawings:
 - 1. Door and panel units: Show types, elevations, thickness of metals, full size profiles of door members.
 - 2. Hardware: Show materials, finishes, locations of fasteners, types of fasteners, locations and types of operating hardware, and details of installation.
 - 3. General: Show connections of units and hardware to other Work. Include schedules showing location of each type and size fo door and panel units.
- B. Product Data: Manufacturer's technical data for each typ of access door and panel assembly, including setting drawings, templates, finish requirements, and details of anchorage devices.
 - 1. Include complete schedule, types, locations, construction details, finishes, latching or locking provisions, and other pertinent data.
- C. Manufactuer's Installation Instuctions: Indicate installation requirements and rough-in dimensions.

QUALITY ASSUARANCE

- A. Single Source Responsibility: Obtain access door and panel units, and frames for entire Project from (1) single manufacturer.
- B. Size Variations: Obtain Architect's acceptance of manufacturer's standard size units, which may vary slightly from sizes indicated.

DELIVERY, STORAGE AND HANDLING

- A. Package and ship per manufacturer's recommendations.
- B. Store in dry area out of direct sunlight.

WARRANTY

- A. Warrant materials and workmanship against defects after completion and final acceptance of Work.
 - 1. Repair defects, or replace with new materials, faulty materials or workmanship developed during the guarantee period at no expense to Owner.
 - 2. Access Panel Warranty: 1 year from date of shipment.

PRODUCTS

MANUFACTURERS

- A. Specifications and Drawings are based on manufacturer's proprietary literature from Elmdor Manufacturing Co. Other manufacturers shall comply with minimum levels of material, color selection, and detailing indicated in the Specifications and Drawings.
- B. Other Manufacturers include the following:
 - 1. Acudor Products Inc.
 - 2. Bar-Co, Inc. Div., Alfab, Inc.
 - 3. The Bilco Company
 - 4. Cesco Products.
 - 5. Nystrom Inc..
 - 6. JL Industries.
 - 7. Karp Associates, Inc.
 - 8. Larsen's Manufacturing Co.
 - 9. Milcor, Inc.
 - 11. The Williams Bros. Corporation of America.
- C. Substitutions in accordance with Section 01 25 00.

MATERIALS

- A. Zinc-Coated Steel Sheet: ASTM A879/A879M, treatment to prepare surface for painting.
- B. Stainless-Steel Sheet: ASTM A240, Type 304 with No. 4 finish according to ASTM A480/ASTM A480M.
- C. Aluminum Plate: ASTM B209/B209M.
- D. Aluminum Shapes: ASTM B221/B221M.
- E. Welding Rods and Bar Electrodes: Select according to AWS specifications for metal alloy welded.

ACCESS PANELS

- A. Provide one (1) 2 feet-0 inches by 2 feet-0 inches at each toilet room plumbing chase wall. If not shown on drawings, coordinate final location with Architect.
- B. Toilet Room Access doors with exposed trim:
 - 1. Exposed Frame Flanges: Nominal 1 inch (25 mm) Wide.
 - 2. Material: 16-gage (1.5-mm) stainless steel.
 - 3. Door Panels: 14-gage (1.8-mm) stainless steel.
 - 4. Finish: Type 304 Stainless Steel, #4 Satin.
- C. Flush Access Doors with Exposed Trim: Units consisting of frame with exposed trim, door, and hardware, and complying with the following requirements:
 - 1. Frame: 0.0598-inch (1.52-mm) thick zinc-coated steel sheet.
 - 2. Door: 0.0747-inch (1.90-mm) thick zinc-coated steel sheet.
 - 3. Trim: Flange integral with frame, 3/4 inch (19 mm) wide, overlapping surrounding finished surface.
 - 4. Hinge: Continuous type.
 - 5. Locks: Flush, screwdriver-operated cam for interior units mounted above 8'-0".
 - 6. Locks: Key-operated cylinder lock for exterior and interior units mounted below 8'-0".

FABRICATION

- A. Manufacture each access panel assembly as an integral unit ready for installation.
- B. Welded construction: Furnish with a sufficient quantity of 1/4 inch mounting holes to secure access panels to types of supports indicated.
- C. Recessed panel: Form face of panel to provide specified recess for application fo finish material. Reinforce panel as required to prevent buckling.
- D. Locking Devices: Furnish number of latches required to hold door in flush, smooth plan when closed.
 - 1. For cylinder lock, furnish 2 keys per lock and key all locks alike.
 - 2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.

PREPARATION

- A. Advise installers of work relating to access panel installation including rough opening dimensions, locations, supports, and anchoring methods. Coordinate delivery with other work to avoid delay.

INSTALLATION

- A. Install access door and frame units per manufacturer's written instructions.
- B. Install frames plumb and level in opening. Secure rigidly in place.
- C. Position units to provide convenient access to concealed Work requiring access.

ADJUST AND CLEAN

- A. Adjust panel after installation for proper operation.

B. Remove and replace panels or frames that are warped, bowed, or damaged.

END OF SECTION 08 31 00

SECTION 08 40 00 – ALUMINUM WINDOWS & FRAMES

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

SUMMARY

A. Section Includes:

1. Exterior glazed aluminum storefront system.
2. Interior glazed aluminum storefront system.
3. Accessories necessary to complete work.
4. Perimeter sealant.
5. Perimeter flashings.
6. Sub-sill flashing.

B. Related Sections:

1. Section 04 20 00 – Unit Masonry Assemblies.
2. Section 05 50 00 - Metal Fabrications.
3. Section 06 10 00 – Rough Carpentry
4. Section 07 84 00 – Firestopping.
5. Section 07 92 00 – Joint Sealants
6. Section 08 71 00 – Door Hardware.
7. Section 08 80 00 – Glazing.
8. Section 09 21 16 – Gypsum Board Assemblies.
9. Section 09 21 13 – Plaster Assemblies.

REFERENCES

A. Aluminum Association (AA):

1. AA ADM 1 - Aluminum Design Manual.
2. DAF-45 Designation System for Aluminum Finishes.

B. American Architectural Manufacturers Association (AAMA):

1. AAMA/WDMA 101/I.S.2 - Specification for Windows, Doors and Unit Skylights.
2. 501.2 Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems.
3. AAMA 502 - Voluntary Specification for Field Testing of Windows and Sliding Glass Doors.
4. 606.1 Specifications and Inspection Methods for Integral Color Anodic Finishes for Architectural Aluminum.
5. 607.1 Specifications and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum.
6. 608.1 Specification and Inspection Methods for Electrolytically Deposited Color Anodic Finishes for Architectural Aluminum.
7. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
8. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
9. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site.
10. AAMA SFM 1 Aluminum Storefront and Entrance Manual.

C. American Society for Testing and Materials (ASTM):

1. ASTM A36 - Standard Specification for Carbon Structural Steel.

2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM A123/A Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
4. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
5. ASTM B221 Standard Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
6. ASTM B308 Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Shapes, Rolled or Extruded.
7. 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.
8. ASTM E330 Standard Specification for Test Method for Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
9. ASTM E331 Standard Specification for Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
10. ASTM E547 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Differential.
11. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Curtain Walls, and Doors by Uniform or Cyclic Static Air Pressure Difference.
12. ASTM E1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
13. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.

SUBMITTALS

- A. Section 01 33 00 - Submittals: Procedures for submittals.
- B. Product Data:
 1. Submit manufacturer's descriptive literature and product specifications.
 2. Include information for factory finishes, hardware, accessories, and other required components.
 3. Include color charts for finish indicating manufacturer's standard colors available for selection.
 4. Provide component dimensions; describe components within assembly, anchorage and fasteners, glass and aluminum composite panels, door hardware, internal drainage details.
- C. Design Data: Provide framing member structural and physical characteristics, calculations and dimensional limitations.
 - a. Submittal drawings and engineering calculations.
 - b. Modifications and final Record Drawings.
- D. Shop Drawings:
 1. Submit shop drawings covering fabrication, installation and finish of specified systems.
 2. Include following:
 - a. Fully dimensioned plans and elevations with detail coordination keys.
 - b. Locations of exposed fasteners and joints.
 3. Provide detailed drawings of:
 - a. Composite members.
 - b. Joint connections for framing systems and for entrance doors.

- c. Anchorage.
 - d. System reinforcements.
 - e. System expansion and contraction provisions.
 - f. Glazing methods and accessories.
 - g. Internal sealant requirements.
 - h. Thermal improvements.
4. Schedule of finishes.

E. Samples:

- 1. Submit manufacturer's standard samples indicating quality of finish.
- 2. Where normal texture or color variations are expected, include additional samples illustrating range of variation.
- 3. Submit two samples 12 x 12 inches in size illustrating finished aluminum frame.

F. Qualification Data: Submit installer qualifications verifying years of experience.

G. Manufacturer's Instructions: Submit manufacturer's printed installation instructions.

QUALITY ASSURANCE

A. Mock-Up:

- 1. Before installing all door or window units, contractor must install a mock-up of each type of unit being installed.
- 2. Architect must approved each mock-up before installation of addition units is allowed. If there is only one unit of a particular stile, its installation shall be approved prior to final caulking.

B. Installer Qualifications: An installer which has had successful experience with installation of the same or similar units required for the project and other projects of similar size and scope.

C. Manufacturer Qualifications: A manufacturer capable of providing aluminum-framed storefront system that meet or exceed performance requirements indicated and of documenting this performance by inclusion of test reports, and calculations.

DELIVERY, STORAGE, AND HANDLING

A. Handle Products of this Section in accordance with AAMA - SFM-1 - Aluminum Store Front and Entrance Manual.

B. Protect finished surfaces as necessary to prevent damage.

C. Protect storefront material against damage from elements, construction activities, and other hazards before, during and after storefront installation.

- 1. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.
- 2. Do not leave coating residue on any surfaces

D. Replace damaged units as required.

MANUFACTURERS

A. Standard Frame Manufacturers

- 1. Kawneer Company Inc. (Basis of Design), www.kawneer.com

2. YKKAP America, Inc. www.ykkap.com
3. U.S. Aluminum, www.usalum.com
4. Oldcastle Buidling Envelope, www.obe.com

B. Stained Glass Frame Manufacturers

1. Sussman Architectural Products (Basis of Design),
www.SussmanAP.com, 109-10 180 St. Jamaica, NY 11422
2. J Petrel Manufacturing
jonpetrel@yahoo.com, 4009 Finegan Crt, Nolensville TN, 37135

C. Substitutions: Submit under provsions of Section 01 25 00.

MATERIALS

- A. Exterior Aluminum frames shall be extruded from 6063-T5 aluminum alloy. Finish to be Architectural Class I, Anodic Coating conforming with Aluminum Association Standard AA-M12-C22-A44, Dark Bronze.
- B. Interior Aluminum frames shall be extruded from 6063-T5 aluminum alloy. Finish to be Permaflour Coating, Kawneer's Antique Bronze – UC100027.
- C. Weather-stripping shall be manufacturer's standard.
- D. Refer to Section 08 80 00 for glazing materials.
- E. Aluminum frames and windows shall be as manufactured by the Kawneer Company & Sussman as detailed on the drawings.
- E. Window & sidelite frame construction:
 1. Exterior Window Frame construction to receive stained glass shall be Sussman 6400 Series, members as detailed on drawings.
 2. Interior Window and Sidelite Frame construction shall be Kawneer Trifab VG 451, 2" x 4 1/2", members as detailed on drawings.
 3. Install using surround system members as detailed on the drawings.
 4. All screws, miscellaneous fastening devices and internal components shall be of stainless steel, plated or corrosion resistant materials of sufficient strength to perform the functions for which they are used.
 5. All frames shall be manufactured with a closed back or with an open back section with "flat aluminum filler" full height at jambs and head. **No open backed frames.**
 6. Provide aluminum break metal closer at head to jamb frame transition and at all vertical mullion to head transitions. Seal and fasten to aluminum frame and frame flat filler at both head and jamb to provide a weather tight seal.
 7. Provide aluminum break metal angle at jambs as detailed on drawings.
 8. Metal "end dams" as manufactured by Kawneer must be used. Shop or field fabricated "end dams" will not be allowed.
 9. Provide additional jamb and head extensions as required to complete wheather-tight assembly.
- F. Shims: plastic, aluminum or stainless steel.

ERECTION

- A. Units shall be installed plumb, level, and true to plane and shall be secured and anchored in accordance with the detailed shop drawings and manufacturer's written instructions.
- B. Aluminum "end dams" must be installed at ends of all sills at both windows and sidelites.
- C. Install all flashings in accordance with manufacturer's instructions.
- D. Set thresholds and exterior frames in bed of mastic and secure. Install stainless steel waterstop beneath thresholds and where frames meet concrete slab as detailed on drawings.
- E. Coordinate installation of new door and window frames and doors with Owner who will be installing access control and other security components and wiring under a separate contract and work closely with Owner in adjusting doors for smooth operation after all security wiring and components are installed.

FIELD QUALITY CONTROL

- A. Section 01 43 00 – Quality Control: Field inspection, testing, and adjusting.
- B. Water Hose Test in accordance with AAMA 501.2-83, after approximately 500 square feet have been installed; repeat for every 500 sq. ft. installed.

PROTECTION & CLEANING

- A. After installation the General Contractor shall take all necessary measures to protect exposed aluminum surfaces and shall be responsible for final cleaning.
- B. Remove protective material from pre-finished aluminum surfaces.
- C. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean exercising care to avoid damage.
- D. Remove excess sealant by method acceptable to sealant manufacturer.

END OF SECTION 08 40 00

SECTION 08 71 00 – DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware for:
 - a. Swinging doors.
2. Field verification, preparation and modification of existing doors and frames to receive new door hardware.

B. Section excludes:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 01 Section "Alternates" for alternates affecting this section.
2. Division 06 Section "Rough Carpentry"
3. Division 06 Section "Finish Carpentry"
4. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
5. Division 08 Sections:
 - a. "Metal Doors and Frames"
 - b. "Flush Wood Doors"
 - c. "Stile and Rail Wood Doors"
 - d. "Interior Aluminum Doors and Frames"
 - e. "Aluminum-Framed Entrances and Storefronts"
 - f. "Stainless Steel Doors and Frames"
 - g. "Special Function Doors"
 - h. "Entrances"
6. Division 09 sections for touchup, finishing or refinishing of existing openings modified by this section.
7. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
8. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

1.02 REFERENCES

A. UL - Underwriters Laboratories

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Key Systems and Nomenclature

C. NFPA – National Fire Protection Association

1. NFPA 70 – National Electric Code
2. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
3. NFPA 101 – Life Safety Code
4. NFPA 105 – Smoke and Draft Control Door Assemblies
5. NFPA 252 – Fire Tests of Door Assemblies

D. ANSI - American National Standards Institute

1. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
2. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems

E. TAS – Texas Accessibility Standards

1. For door hardware on doors in an accessible route, comply with provisions in the TDLR “2012 Accessibility Standards “ (TAS).

1.03 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:
 - a. Comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, “EXAMINATION” article, herein.
 - b. Review drawings and Sections from related trades to verify compatibility with specified hardware.
 - c. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.

2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
 - a. Wiring Diagrams: For power, signal, and control wiring and including:
 - 1) Details of interface of electrified door hardware and building safety and security systems.
 - 2) Schematic diagram of systems that interface with electrified door hardware.
 - 3) Point-to-point wiring.
 - 4) Risers.
3. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.
 - a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
4. Door Hardware Schedule:
 - a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
 - b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
 - c. Indicate complete designations of each item required for each opening, include:
 - 1) Door Index: door number, heading number, and Architect's hardware set number.
 - 2) Quantity, type, style, function, size, and finish of each hardware item.
 - 3) Name and manufacturer of each item.
 - 4) Fastenings and other pertinent information.
 - 5) Location of each hardware set cross-referenced to indications on Drawings.
 - 6) Explanation of all abbreviations, symbols, and codes contained in schedule.
 - 7) Mounting locations for hardware.
 - 8) Door and frame sizes and materials.
 - 9) Degree of door swing and handing.
 - 10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.
5. Key Schedule:
 - a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
 - b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
 - c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
 - d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.

- e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
 - f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.
6. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory or shop prepared for door hardware installation.
- C. Informational Submittals:
1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
 2. Provide Product Data:
 - a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
 - b. Include warranties for specified door hardware.
- D. Closeout Submittals:
1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
 - a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
 - b. Catalog pages for each product.
 - c. Factory order acknowledgement numbers (for warranty and service)
 - d. Name, address, and phone number of local representative for each manufacturer.
 - e. Parts list for each product.
 - f. Final approved hardware schedule edited to reflect conditions as-installed.
 - g. Final keying schedule
 - h. Copies of floor plans with keying nomenclature
 - i. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
 - j. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

1.04 QUALITY ASSURANCE

- A. Qualifications and Responsibilities:
1. Supplier: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
 - a. Warehousing Facilities: In Project's vicinity.
 - b. Scheduling Responsibility: Preparation of door hardware and keying schedules.
 - c. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

- d. Coordination Responsibility: Assist in coordinating installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.
 - 1) Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.
 2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
 3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
 - a. For door hardware: DHI certified AHC or DHC.
 - b. Can provide installation and technical data to Architect and other related subcontractors.
 - c. Can inspect and verify components are in working order upon completion of installation.
 - d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.
 4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.
- B. Certifications:
1. Fire-Rated Door Openings:
 - a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
 - b. Provide only items of door hardware that are listed products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.
 2. Smoke and Draft Control Door Assemblies:
 - a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
 - b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.
 3. Electrified Door Hardware
 - a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
 4. Accessibility Requirements:
 - a. Comply with governing accessibility regulations cited in "REFERENCES" article, herein for door hardware on doors in an accessible route.
- C. Pre-Installation Meetings

1. Keying Conference

- a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
 - 1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - 2) Preliminary key system schematic diagram.
 - 3) Requirements for key control system.
 - 4) Requirements for access control.
 - 5) Address for delivery of keys.

2. Pre-installation Conference

- a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
- b. Inspect and discuss preparatory work performed by other trades.
- c. Inspect and discuss electrical roughing-in for electrified door hardware.
- d. Review sequence of operation for each type of electrified door hardware.
- e. Review required testing, inspecting, and certifying procedures.
- f. Review questions or concerns related to proper installation and adjustment of door hardware.

3. Electrified Hardware Coordination Conference:

- a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.
- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.
- C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
- D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
- F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.06 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
- E. Existing Openings: Where existing doors, frames and/or hardware are to remain, field verify existing functions, conditions and preparations and coordinate to suit opening conditions and to provide proper door operation.

1.07 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.
 - 1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
 - 2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.
 - a. Locksets:
 - 1) 10 year mechanical
 - b. Exit Devices
 - 1) 10 year mechanical
 - c. Closers
 - 1) 30 year mechanical

1.08 MAINTENANCE

- A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.
- B. Turn over unused materials to Owner for maintenance purposes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Approval of manufacturers and/or products other than those listed as “Scheduled Manufacturer” or “Acceptable Manufacturers” in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.
- B. Approval of products from manufacturers indicated in “Acceptable Manufacturers” is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer’s product.
- C. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect’s approval.

2.02 MATERIALS

A. Fasteners

- 1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
 - 2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
 - 3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Architect if thru-bolts are required.
 - 4. Install hardware with fasteners provided by hardware manufacturer.
- B. Modification and Preparation of Existing Doors: Where existing door hardware is indicated to be removed and reinstalled.
- 1. Provide necessary fillers, Dutchmen, reinforcements, and fasteners, compatible with existing materials, as required for mounting new opening hardware and to cover existing door and frame preparations.
 - 2. Use materials which match materials of adjacent modified areas.
 - 3. When modifying existing fire-rated openings, provide materials permitted by NFPA 80 as required to maintain fire-rating.
- C. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.
- 1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

2.03 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Ives 5BB series.

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
 - a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
 - b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
3. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
 - a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
4. 2 inches or thicker doors:
 - a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
5. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
6. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.
7. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 - a. Steel Hinges: Steel pins
 - b. Non-Ferrous Hinges: Stainless steel pins
 - c. Out-Swinging Exterior Doors: Non-removable pins
 - d. Out-Swinging Interior Lockable Doors: Non-removable pins
 - e. Interior Non-lockable Doors: Non-rising pins
8. Width of hinges: 4-1/2 inches (114 mm) at 1-3/4 inch (44 mm) thick doors, and 5 inches (127 mm) at 2 inches (51 mm) or thicker doors. Adjust hinge width as required for door, frame, and wall conditions to allow proper degree of opening.
9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component.
10. Provide mortar guard for each electrified hinge specified.
11. Provide spring hinges where specified. Provide two spring hinges and one bearing hinge per door leaf for doors 90 inches (2286 mm) or less in height. Provide one additional bearing hinge for each 30 inches (762 mm) of additional door height.

2.04 CONTINUOUS HINGES

A. Aluminum Geared

1. Manufacturers:
 - a. Scheduled Manufacturer: Ives.
2. Requirements:
 - a. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.

- b. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
- c. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
- d. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
- e. On fire-rated doors, provide aluminum geared continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
- f. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware.
- g. Install hinges with fasteners supplied by manufacturer.
- h. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.05 FLUSH BOLTS

A. Manufacturers:

- 1. Scheduled Manufacturer: Ives.

B. Requirements:

- 1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.06 COORDINATORS

A. Manufacturers:

- 1. Scheduled Manufacturer: Ives.

B. Requirements:

- 1. Where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.
- 2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers, surface vertical rod exit device strikes or other stop mounted hardware. Factory-prepared coordinators for vertical rod devices as specified.

2.07 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products:

- 1. Scheduled Manufacturer and Product: Schlage ND series.

B. Requirements:

1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3 hour fire doors.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2 inch latch throw. Provide proper latch throw for UL listing at pairs.
4. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
5. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
7. Provide electrified options as scheduled in the hardware sets.
8. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.
 - a. Lever Design: Schlage Sparta

2.08 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Von Duprin 99/33A series.

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
7. Provide flush end caps for exit devices.
8. Provide exit devices with manufacturer's approved strikes.
9. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
10. Mount mechanism case flush on face of doors, or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
11. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
12. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
13. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
14. Provide electrified options as scheduled.
15. Top latch mounting: double or single tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
16. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

2.09 ELECTRONIC ACCESS CONTROL LOCKSETS AND EXIT DEVICE TRIM

A. Manufacturers:

1. Scheduled Manufacturer and Product: Schlage CO Series.

B. Requirements:

1. Provide offline electronic access control products that comply with the following requirements:
 - a. Listed, UL 294 - The Standard of Safety for Access Control System Units.
 - b. Compliant with ANSI/BHMA A156.25 Grade 1 Operation and Security.
 - c. Certified to UL10C, FCC Part15, Florida Building Code Standards TAS 201 large missile impact, TAS 202 and TAS 203.
 - d. Compliant with ASTM E330 for door assemblies.
 - e. Compliant with ICC / ANSI A117.1, NFPA 101, NFPA 80, and Industry Canada RSS-210.
2. Chassis:
 - a. Cylindrical
3. Functions: Provide functions as scheduled that are field configurable without taking the offline electronic product off the door.
4. Emergency Override: Provide mechanical key override; cylinders: Refer to "KEYING" article, herein.
5. Levers:
 - a. Vandal Resistance: Exterior (secure side) lever rotates freely while door remains locked, preventing damage to internal lock components from vandalism by excessive force.
 - b. Provide pressure cast zinc plated, non-handed lever trim that operates independently of non-locking levers.
 - c. Style: Sparta
6. Power Supply: 4 AA batteries
 - a. Provide electronic access control locks and/or exit device trim with the ability to communicate battery status.
7. Features:
 - a. Visual tri-colored LED indicators that indicate activation, operational systems status, system error conditions and low power conditions.
 - b. Visual bi-colored LED indicator on interior that is capable of indicating secured/unsecured status of device to occupants on interior.
 - c. Audible feedback that can be enabled or disabled.
 - d. Central verification time of less than 1 second
 - e. Tamper-Resistant Screws: Tamper torx screws on inside escutcheon for increased security.
 - f. Integral door position switch.
8. Access:
 - a. Programmable Keypad
 - 1) 3-6 digit PIN code and 12 backlit buttons in a 3 x 4 matrix.

9. Operation:

- a. Provide electronic access control locks and/or exit device trim with the ability to be configured at door by handheld programming device the length of time device is unlocked upon access grant.
- b. Provide electronic access control locks and/or exit device trim with the ability to communicate identifying information such as firmware versions, hardware versions, serial numbers, and manufacturing dates by handheld programming device.

10. Users:

- a. User rights to be stored on the lock.
- b. Limited to 500 users.

2.10 CYLINDERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Schlage Everest 29.

B. Requirements:

1. Provide cylinders/cores, from the same manufacturer of locksets, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.
2. Provide cylinders in the below-listed configuration(s), distributed throughout the Project as indicated.
 - a. Conventional Patented Open: cylinder with interchangeable core with open keyway.
3. Patent Protection: Cylinders/cores requiring use of restricted, patented keys, patent-protected until the year, 2029.
4. Nickel silver bottom pins.

C. Construction Keying:

1. Replaceable Construction Cores.
 - a. Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
 - 1) 3 construction control keys
 - 2) 12 construction change (day) keys.

2.11 KEYING

- ### A. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Requirements:

1. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
 - a. Master Keying system as directed by the Owner.

2. Forward biting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
3. Provide keys with the following features:
 - a. Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
 - b. Patent Protection: Keys and blanks protected by one or more utility patent(s) until the year, 2029.
4. Identification:
 - a. Identification stamping provisions must be approved by the Architect and Owner.
 - b. Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
 - c. Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
 - d. Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
5. Quantity: Furnish in the following quantities.
 - a. Change (Day) Keys: 3 per cylinder/core.
 - b. Permanent Control Keys: 3.
 - c. Master Keys: 6.

2.12 KEY CONTROL SYSTEM

A. Requirements:

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
 - a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
 - b. Provide hinged-panel type cabinet for wall mounting.

2.13 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: LCN 4040XP series.

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.

3. Cylinder Body: 1-1/2 inch (38 mm) diameter with 5/8 inch (16 mm) diameter double heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.14 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer: Ives.

B. Requirements:

1. Provide push plates, push bars, pull plates, and pulls with diameter and length as scheduled.

2.15 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer: Ives.

B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
3. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.16 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers: Glynn-Johnson.

B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.
2. Provide friction type at doors without closer and positive type at doors with closer.

2.17 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer: Ives.

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button or thumbturn.
2. Where a wall stop cannot be used, provide universal floor stops.
3. Where wall or floor stop cannot be used, provide overhead stop.
4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

2.18 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer: Zero International.

B. Requirements:

1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

2.19 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer: Ives.

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.20 DOOR POSITION SWITCHES

A. Manufacturers:

1. Scheduled Manufacturer: Schlage.

B. Requirements:

1. Provide recessed or surface mounted type door position switches as specified.
2. Coordinate door and frame preparations with door and frame suppliers. If switches are being used with magnetic locking device, provide minimum of 4 inches (102 mm) between switch and magnetic locking device.

2.21 FINISHES

A. Finish: BHMA 613/640 (US10B); except:

1. Continuous Hinges: US32D (BHMA 630).
2. Continuous Hinges: BHMA 710 (US10B)
3. Door Closers: Powder Coat to Match.
4. Latch Protectors: US32D (BHMA 630).
5. Weatherstripping: Dark Bronze Anodized Aluminum.
6. Thresholds: Extruded Architectural Bronze, Oil-Rubbed

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.
- B. Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.
- C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- D. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Where on-site modification of doors and frames is required:

1. Carefully remove existing door hardware and components being reused. Clean, protect, tag, and store in accordance with storage and handling requirements specified herein.
2. Field modify and prepare existing doors and frames for new hardware being installed.
3. When modifications are exposed to view, use concealed fasteners, when possible.

4. Prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:
 - a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
 - b. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
 - c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

3.03 INSTALLATION

- A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 2. Custom Steel Doors and Frames: HMMA 831.
 3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.
- H. Lock Cylinders:
 1. Install construction cores to secure building and areas during construction period.
 2. Replace construction cores with permanent cores as indicated in keying section.
 3. Furnish permanent cores to Owner for installation.
- I. Wiring: Coordinate with Division 26, ELECTRICAL sections for:
 1. Conduit, junction boxes and wire pulls.
 2. Connections to and from power supplies to electrified hardware.
 3. Connections to fire/smoke alarm system and smoke evacuation system.
 4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
 5. Testing and labeling wires with Architect's opening number.

- J. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- K. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.
- L. Closer/holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
- M. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.
- N. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- O. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
- P. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- Q. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- R. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.04 FIELD QUALITY CONTROL

- A. Engage qualified, independent, Door Hardware Institute (DHI) Certified, Fire Door Assembly Inspector (CFDAI) or Architectural Hardware Consultant (AHC) to perform inspections, prepare inspection reports, and issue inspection reports.
 - 1. Representative will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.
 - 2. Representative will inspect fire rated doors and state in report whether installed work complies with NFPA 80.

3.05 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.06 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items per manufacturer's instructions to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.07 DOOR HARDWARE SCHEDULE

- A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.
- B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.
- C. Hardware items are referenced in the following hardware schedule. Refer to the above-specifications for special features, options, cylinders/keying, and other requirements.

D. Hardware Sets:
125743 OPT0407223 VERSION 1

HARDWARE GROUP NO. 002

QTY	DESCRIPTION NOTE	CATALOG NUMBER CASED OPENING, NO HARDWARE	FINISH	MFR
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HARDWARE GROUP NO. 105W

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5 NRP	B643E/ 716	IVE
1	EA	ENTRANCE LOCK	ND53TD SPA	643E	SCH
1	EA	FSIC PERMANENT CORE	23-030	606	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	613	IVE
1	EA	RAIN DRIP	142D DW + 4" (OMIT @ COVERED OPENINGS)	D	ZER
1	SET	GASKETING	328D H & J	D	ZER
1	EA	DOOR SWEEP	8198D	D	ZER
1	EA	THRESHOLD	65D	D	ZER

HARDWARE GROUP NO. 201

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	F643E/ 716	IVE
1	EA	STOREROOM LOCK	ND80TD SPA	643E	SCH
1	EA	FSIC PERMANENT CORE	23-030	606	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	613	IVE
1	EA	DOOR STOP	WS407CCV/FS439 AS REQ	643E/7 16	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BR	ZER

HARDWARE GROUP NO. 203

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	F643E/ 716	IVE
1	EA	STOREROOM LOCK	ND80TD SPA	643E	SCH
1	EA	FSIC PERMANENT CORE	23-030	606	SCH
1	EA	DOOR STOP	WS407CCV/FS439 AS REQ	643E/7 16	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BR	ZER

HARDWARE GROUP NO. 207

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	F643E/ 716	IVE
1	EA	STOREROOM LOCK	ND80TD SPA	643E	SCH
1	EA	FSIC PERMANENT CORE	23-030	606	SCH
1	EA	OH STOP	90S	643E/7 16	GLY
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	613	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BR	ZER

HARDWARE GROUP NO. 341

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	F643E/ 716	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR	ND40S SPA OS-OCC	643E	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	613	IVE
1	EA	DOOR STOP	WS407CCV/FS439 AS REQ	643E/7 16	IVE
1	EA	GASKETING	488S PSA H & J	BR	ZER

-OCCUPIED/VACANT INDICATOR ON OUTSIDE OF DOOR.

HARDWARE GROUP NO. 341C

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	F643E/ 716	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR	ND40S SPA OS-OCC	643E	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	613	IVE
1	EA	GASKETING	488S PSA H & J	BR	ZER

-OCCUPIED/VACANT INDICATOR ON OUTSIDE OF DOOR.

HARDWARE GROUP NO. 403

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	F643E/ 716	IVE
1	EA	PASSAGE SET	ND10S SPA	643E	SCH
1	EA	DOOR STOP	WS407CCV/FS439 AS REQ	643E/7 16	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BR	ZER

HARDWARE GROUP NO. 403G

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	F643E/ 716	IVE
1	EA	PASSAGE SET	ND10S SPA	643E	SCH
1	EA	DOOR STOP	WS407CCV/FS439 AS REQ	643E/7 16	IVE
1	SET	DOOR SWEEP	328D	D	ZER
1	EA	GASKETING	488S PSA H & J	BR	ZER
1	EA	THRESHOLD	544D	D	ZER

HARDWARE GROUP NO. 800HL

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5	F643E/ 716	IVE
2	EA	MANUAL FLUSH BOLT	FB358/FB458 AS REQ	643E/7 16	IVE
1	EA	DUST PROOF STRIKE	DP2	643E/7 16	IVE
1	EA	CLASSROOM DEAD LOCK	L463T	643E	SCH
1	EA	FSIC PERMANENT CORE	23-030	606	SCH
2	EA	PUSH PLATE	8200 6" X 16"	613	IVE
2	EA	PULL PLATE	8303 10" 6" X 16" F	613	IVE
2	EA	SURFACE CLOSER	4040XP HEDA TBSRT X MTG BRKT, SPCR, PLATE	695	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	613	IVE
2	EA	DOOR STOP	WS407CCV/FS439 AS REQ	643E/7 16	IVE
2	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 801

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	F643E/ 716	IVE
1	EA	PUSH PLATE	8200 6" X 16"	613	IVE
1	EA	PULL PLATE	8303 10" 6" X 16" F	613	IVE
1	EA	HANDS FREE FOOT PULL	FP100	695	IVE
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	613	IVE
1	EA	DOOR STOP	WS407CCV/FS439 AS REQ	643E/7 16	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 804LT

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
8	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	B643E/ 716	IVE
2	EA	MANUAL FLUSH BOLT	FB358/FB458 AS REQ	643E/7 16	IVE
1	EA	DUST PROOF STRIKE	DP2	643E/7 16	IVE
1	EA	DBL CYL DEAD LOCK	L462T	643E	SCH
2	EA	FSIC PERMANENT CORE	23-030	606	SCH
2	EA	PUSH PLATE	8200 6" X 16"	613	IVE
2	EA	OFFSET LONG DOOR PULL	9264F 36" X MTG AS REQ	643E/7 16	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE	695	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	613	IVE
1	EA	RAIN DRIP	142D DW + 4" (OMIT @ COVERED OPENINGS)	D	ZER
1	SET	GASKETING	328D H & J	D	ZER
1	SET	MEETING STILE	8193D (2 PCS - 1 SET)	D	ZER
2	EA	DOOR SWEEP	8198D	D	ZER
1	EA	THRESHOLD	65D	D	ZER

HARDWARE GROUP NO. 806L

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5	 F643E/ 716	IVE
2	EA	MANUAL FLUSH BOLT	FB358/FB458 AS REQ	 643E/7 16	IVE
1	EA	DUST PROOF STRIKE	DP2	 643E/7 16	IVE
1	EA	CLASSROOM DEAD LOCK	L463T	 643E	SCH
1	EA	FSIC PERMANENT CORE	23-030	 606	SCH
2	EA	PUSH PLATE	8200 6" X 16"	 613	IVE
2	EA	PULL PLATE	8303 10" 6" X 16" F	 613	IVE
2	EA	OH STOP	100S	 643E/7 16	GLY
2	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE	 695	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	 613	IVE
1	SET	MEETING STILE	328D (2 PCS - 1 SET)	 D	ZER
1	EA	GASKETING	488S PSA H & J	 BR	ZER

HARDWARE GROUP NO. AC715

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	B643E/ 716	IVE
1	EA	POWER TRANSFER	EPT10 CON	695	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-99-NL-CON	313	VON
1	EA	RIM CYLINDER	20-057 ICX W/KEYED CONST. CORE	643E	SCH
1	EA	FSIC PERMANENT CORE	23-030	606	SCH
1	EA	OH STOP	100S	643E/7 16	GLY
1	EA	SURF. AUTO OPERATOR	9542 SERIES AS REQ	ANDKB	LCN
1	EA	ACTUATOR PKG	8310-3857T (1 PKG, 2 ACTUATORS)	630	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	613	IVE
1	EA	RAIN DRIP	142D DW + 4" (OMIT @ COVERED OPENINGS)	D	ZER
1	SET	GASKETING	328D H & J	D	ZER
1	EA	DOOR SWEEP	8198D	D	ZER
1	EA	THRESHOLD	65D	D	ZER
1	EA	WIRE HARNESS (IN DOOR)	CON- TYPE & LENGTH AS REQ		SCH
1	EA	WIRE HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS		SCH
1	EA	CONTROLLER	CTE-MTB11/MTB15-485-B (VOLT AS REQ) BY SEC CONTRACTOR	B	SCE
1	EA	CREDENTIAL READER	MTB11/MTB15 AS REQ BY SEC CONTRACTOR		
1	EA	DOOR CONTACT	679-05 TYPE AS REQ (COORDINATE DPS WITH SEC CONTRACTOR PRIOR TO SUBMITTALS)	BLK	SCE
1	EA	POWER SUPPLY	BY SEC CONTRACTOR		

-ENTRY BY THE CREDENTIAL READER OR KEY OVERRIDE.

-FREE EGRESS BY THE ACTUATOR OR THE PUSH PAD.

-THE ELECTRIFIED LATCH BOLT WILL BE SEQUENCED WITH THE AUTOMATIC OPENER AND
RETRACT PRIOR TO THE AUTOMATIC OPENER ACTIVATING.

-COORDINATE POWER SUPPLY WITH SECURITY CONTRACTOR PRIOR TO SUBMITTALS.

HARDWARE GROUP NO. AC715T

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	B643E/ 716	IVE
1	EA	POWER TRANSFER	EPT10 CON	695	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-99-NL-CON	313	VON
1	EA	RIM CYLINDER	20-057 ICX W/KEYED CONST. CORE	643E	SCH
1	EA	FSIC PERMANENT CORE	23-030	606	SCH
1	EA	OH STOP	100S	643E/7 16	GLY
1	EA	SURF. AUTO OPERATOR	9542 SERIES AS REQ	ANDKB	LCN
1	EA	ACTUATOR PKG	8310-3857T (1 PKG, 2 ACTUATORS)	630	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	613	IVE
1	EA	RAIN DRIP	142D DW + 4" (OMIT @ COVERED OPENINGS)	D	ZER
1	SET	GASKETING	328D H & J	D	ZER
1	EA	DOOR SWEEP	8198D	D	ZER
1	EA	THRESHOLD	65D	D	ZER
1	EA	WIRE HARNESS (IN DOOR)	CON- TYPE & LENGTH AS REQ		SCH
1	EA	WIRE HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS		SCH
1	EA	CONTROLLER	CTE-MTB11/MTB15-485-B (VOLT AS REQ) BY SEC CONTRACTOR	B	SCE
1	EA	CREDENTIAL READER	MTB11/MTB15 AS REQ BY SEC CONTRACTOR		
1	EA	DOOR CONTACT	679-05 TYPE AS REQ (COORDINATE DPS WITH SEC CONTRACTOR PRIOR TO SUBMITTALS)	BLK	SCE
1	EA	POWER SUPPLY	BY SEC CONTRACTOR		

-ENTRY BY THE CREDENTIAL READER OR KEY OVERRIDE.

-FREE EGRESS BY THE ACTUATOR OR THE PUSH PAD.

-THE ELECTRIFIED LATCH BOLT WILL BE SEQUENCED WITH THE AUTOMATIC OPENER AND
RETRACT PRIOR TO THE AUTOMATIC OPENER ACTIVATING.

-COORDINATE POWER SUPPLY WITH SECURITY CONTRACTOR PRIOR TO SUBMITTALS.

HARDWARE GROUP NO. C710

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5	F643E/ 716	IVE
2	EA	POWER TRANSFER	EPT10 CON	695	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-9947-L-DT-LBR-17-CON (WDC @ WD)	313	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-9947-L-NL-LBR-17-CON (WDC @ WD)	313	VON
1	EA	RIM CYLINDER	20-057 ICX W/KEYED CONST. CORE	643E	SCH
1	EA	FSIC PERMANENT CORE	23-030	606	SCH
2	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE	695	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	613	IVE
2	EA	DOOR STOP	WS407CCV/FS439 AS REQ	643E/7 16	IVE
2	EA	SILENCER	SR64	GRY	IVE
2	EA	WIRE HARNESS (IN DOOR)	CON- TYPE & LENGTH AS REQ		SCH
2	EA	WIRE HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS		SCH
1	EA	CONTROLLER	CTE-MTB11/MTB15-485-B (VOLT AS REQ) BY SEC CONTRACTOR	B	SCE
1	EA	CREDENTIAL READER	MTB11/MTB15 AS REQ BY SEC CONTRACTOR		
2	EA	DOOR CONTACT	679-05 TYPE AS REQ (COORDINATE DPS WITH SEC CONTRACTOR PRIOR TO SUBMITTALS)	BLK	SCE
1	EA	POWER SUPPLY	BY SEC CONTRACTOR		

-ENTRY BY THE CREDENTIAL READER OR KEY OVERRIDE.

-FREE EGRESS BY THE PUSH PADS.

-COORDINATE POWER SUPPLY WITH SECURITY CONTRACTOR PRIOR TO SUBMITTALS.

HARDWARE GROUP NO. C715

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	B643E/ 716	IVE
1	EA	POWER TRANSFER	EPT10 CON	695	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-99-NL-CON	313	VON
1	EA	RIM CYLINDER	20-057 ICX W/KEYED CONST. CORE	643E	SCH
1	EA	FSIC PERMANENT CORE	23-030	606	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	613	IVE
1	EA	RAIN DRIP	142D DW + 4" (OMIT @ COVERED OPENINGS)	D	ZER
1	SET	GASKETING	328D H & J	D	ZER
1	EA	DOOR SWEEP	8198D	D	ZER
1	EA	THRESHOLD	65D	D	ZER
1	EA	WIRE HARNESS (IN DOOR)	CON- TYPE & LENGTH AS REQ		SCH
1	EA	WIRE HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS		SCH
1	EA	CONTROLLER	CTE-MTB11/MTB15-485-B (VOLT AS REQ) BY SEC CONTRACTOR	B	SCE
1	EA	CREDENTIAL READER	MTB11/MTB15 AS REQ BY SEC CONTRACTOR		
1	EA	DOOR CONTACT	679-05 TYPE AS REQ (COORDINATE DPS WITH SEC CONTRACTOR PRIOR TO SUBMITTALS)	BLK	SCE
1	EA	POWER SUPPLY	BY SEC CONTRACTOR		

-ENTRY BY THE CREDENTIAL READER OR KEY OVERRIDE.

-FREE EGRESS BY THE PUSH PAD.

-COORDINATE POWER SUPPLY WITH SECURITY CONTRACTOR PRIOR TO SUBMITTALS.

HARDWARE GROUP NO. C715T

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	B643E/ 716	IVE
1	EA	POWER TRANSFER	EPT10 CON	695	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-99-NL-CON	313	VON
1	EA	RIM CYLINDER	20-057 ICX W/KEYED CONST. CORE	643E	SCH
1	EA	FSIC PERMANENT CORE	23-030	606	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	613	IVE
1	EA	RAIN DRIP	142D DW + 4" (OMIT @ COVERED OPENINGS)	D	ZER
1	SET	GASKETING	328D H & J	D	ZER
1	EA	DOOR SWEEP	8198D	D	ZER
1	EA	THRESHOLD	65D	D	ZER
1	EA	WIRE HARNESS (IN DOOR)	CON- TYPE & LENGTH AS REQ		SCH
1	EA	WIRE HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS		SCH
1	EA	CONTROLLER	CTE-MTB11/MTB15-485-B (VOLT AS REQ) BY SEC CONTRACTOR	B	SCE
1	EA	CREDENTIAL READER	MTB11/MTB15 AS REQ BY SEC CONTRACTOR		
1	EA	DOOR CONTACT	679-05 TYPE AS REQ (COORDINATE DPS WITH SEC CONTRACTOR PRIOR TO SUBMITTALS)	BLK	SCE
1	EA	POWER SUPPLY	BY SEC CONTRACTOR		

-ENTRY BY THE CREDENTIAL READER OR KEY OVERRIDE.

-FREE EGRESS BY THE PUSH PAD.

-COORDINATE POWER SUPPLY WITH SECURITY CONTRACTOR PRIOR TO SUBMITTALS.

HARDWARE GROUP NO. K201

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	F643E/ 716	IVE
1	EA	ELEC CLASSROOM LOCK	CO-100-CY-70-KP-SPA-J 4B BATTERY OPERATED	643E	SCE
1	EA	FSIC PERMANENT CORE	23-030	606	SCH
1	EA	FSIC CONST. CORE	23-030 ICX	ORG	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	613	IVE
1	EA	DOOR STOP	WS407CCV/FS439 AS REQ	643E/7 16	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BR	ZER

-ENTRY BY THE KEYPAD OR KEY OVERRIDE.
-FREE EGRESS BY THE LEVER.

HARDWARE GROUP NO. K201W

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 5 X 4.5	F643E/ 716	IVE
1	EA	ELEC CLASSROOM LOCK	CO-100-CY-70-KP-SPA-J 4B BATTERY OPERATED	643E	SCE
1	EA	FSIC PERMANENT CORE	23-030	606	SCH
1	EA	FSIC CONST. CORE	23-030 ICX	ORG	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	613	IVE
1	EA	DOOR STOP	WS407CCV/FS439 AS REQ	643E/7 16	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BR	ZER

-ENTRY BY THE KEYPAD OR KEY OVERRIDE.
-FREE EGRESS BY THE LEVER.

HARDWARE GROUP NO. K207W

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5		F643E/ 716	IVE
1	EA	ELEC CLASSROOM LOCK	CO-100-CY-70-KP-SPA-J 4B BATTERY OPERATED		643E	SCE
1	EA	FSIC PERMANENT CORE	23-030		606	SCH
1	EA	FSIC CONST. CORE	23-030 ICX		ORG	SCH
1	EA	OH STOP	90S		643E/7 16	GLY
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE		695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		613	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)		BR	ZER

-ENTRY BY THE KEYPAD OR KEY OVERRIDE.
-FREE EGRESS BY THE LEVER.

END OF SECTION

SECTION 08 80 00 – GLAZING

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

REFERENCE SPECIFICATIONS

- A. Work under this section shall be governed by the current editions of the following standards and specifications to the extent that they are applicable:
 - 1. Glass shall conform to Federal Specifications DD-G-451C. Qualities to be the highest of their categories.
 - 2. Installation shall conform to the requirements of the Flat Glass Manufacturers Association.

APPROVED SUPPLIERS

- A. Glass:
 - 1. Guardian Industries.
 - 2. American Saint-Gobain (ASG)
 - 3. Libbey-Owens-Ford Company (LOF)
 - 4. Pittsburgh Plate Glass Company (PPG) (Basis-of-Design)
 - 5. American Flat Glass Company (AFG)
 - 6. Pilkington.

EXTERIOR GLAZING

- A. Provide all glass and glazing with the manufacturer's label intact. Do not remove labels until glass and glazing has been installed and inspected.
- B. Aluminum Storefront: Exterior glass shall be 1" thick tempered insulated glass, PPG Solarban 60 on Solargray (2), 1/2" air, Clear. Glass shall have a Solar Heat Gain Coefficient (SHGC) of 0.25, and a U-Value of 0.29 with Visible Light Transmittance (VLT) 35%.

INTERIOR GLASS

- A. General interior glass shall be 1" thick clear tempered insulated safety glass. Refer to drawings for material schedule and locations.
- B. One-way interior glass shall be Pilkington Mirrorpane 1" thick tempered insulated safety glass with Visible Transmittance 11%, Visible Reflected Coated Side 68%, Visible Reflected Glass side 16%. Refer to the drawings for material schedule and locations.
- C. Non-framed mirrors shall be 1/4" thick commercial quality polished plate glass with silver backing. Refer to toilet accessories schedule for quantity and locations

GLAZING SEALANTS

- A. Glazing Materials at Hollow Metal Frames:
 - 1. General: Use glazing compounds and preformed glazing sealants approved for the application and, except as otherwise specified, conforming to Glazing Materials portion of FGMA Glazing Manual.
 - 2. Sealant:

- a. One (1) part acrylic polymer sealant conforming to FS TT-S-00230 or silicone, FS TT-S-0023-C. Use for glazing of all fixed glass. Include primer as recommended by manufacturer.
 - b. Color: To match frame.
 - c. All sealants shall be compatible with adjacent material per manufacturer's instruction.
 3. Setting Blocks: Hard rubber or clean grain softwood.
 4. Back-up material: Foamed polyethylene or polystyrene rodstock, sizes as required by joint condition, and compatible with sealant.
 5. Glazing Tape: DAP #1202 or as approved.
 6. Glazing Gaskets: Extruded neoprene, free of porosity, surface defects, dimensional irregularities and conforming to physical properties of ASTM C509.
 7. Use of metal sash putty will not be permitted, but compound conforming to FS T-G-410 will be permitted. The use of nonskinning compounds, nonresilient type preformed sealers, and preformed impregnated type gasket will not be permitted.
- B. Glazing Materials at Aluminum Framing:
1. Glazing Gaskets: Extruded neoprene (Color: Black) sized to fit the frame.
 2. Sealant: Comply with Federal Spec. TT-S-00230

MISCELLANEOUS GLAZING MATERIALS:

- A. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.
- B. Setting Blocks: Neoprene, EPDM or TPV material recommended by glass manufacturer, 80 to 90 Shore A durometer hardness, length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.
- C. Spacer Shims: Neoprene, EPDM or TPV material recommended by glass manufacturer, 50 to 60 Shore A durometer hardness, minimum 3 inch long x one half the height of glazing stop x thickness to suit application.
- D. Compressible Filler (Rod): Closed-cell or waterproof-jacketed rod stock of synthetic rubber or plastic foam, proven to be compatible with sealants used, flexible and resilient, with 5-10 psi compression strength for 25% deflection.
- E. Glazing Clips: Manufacturer's standard type.

GLAZING PROCEDURES

- A. In pressed steel frames, clean glass and rabbet of dirt, moisture and oil. Apply ample glazing compound, as approved by glass or glazing panel manufacturer, to rabbet. Center glass or glazing panel in frame. Press glass or glazing panel into rabbet allowing 1/8" depth of back putty. Butter continuous stop bead against glass or glazing panel, allowing 1/8" bed of compound between glass or glazing panel face and stop bead. Strike surplus compound from both sides of glass or glazing panel.
- B. Screw on continuous glazing bead furnished by hollow metal door and frame manufacturer. Confirm with General Contractor that interior sides of fixed and applied stops have been painted with final color prior to glass installation.
- C. In aluminum window units use extruded aluminum glazing beads and elastomeric gaskets as furnished by the system manufacturer.

- D. Mirrors shall be installed with continuous polished chrome "J" trim top and bottom and mirror mastic.

PROTECTION & CLEANING

- A. After installation the General Contractor shall take all necessary measures to protect glass surfaces and shall be responsible for final cleaning.
- B. At completion of work and immediately prior to final inspection, remove all dirt, stains, etc., from glass and adjacent finishes. Clean both sides of glass.
- C. Do not use acid solutions or water containing caustic soaps. Use commercial cleaning solutions and methods acceptable to the manufacturers of the glass.

END OF SECTION 08 80 00

SECTION 09 21 13 – PLASTER ASSEMBLIES

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

SCOPE

- A. Install plaster ceilings as scheduled and otherwise detailed on the drawings
- B. Section Includes:
 - 1. Metal Lath
 - 2. Cement Plaster Work
- C. Requirements:
 - 1. Division 01 Sections – General provisions.
 - 2. Section 03 26 00 – Concrete Anchors.
 - 3. Section 04 20 00 – Unit Masonry Assemblies.
 - 4. Section 05 50 00 – Metal Fabrications.
 - 5. Section 06 10 00 – Rough Carpentry.
 - 6. Section 07 21 12 – Board (Rigid) Insulation.
 - 7. Section 07 27 20 – Fluid Applied Air Barrier Assembly.
 - 8. Section 09 21 16 – Gypsum Board Assemblies.
 - 9. Section 09 90 00 – Painting (paint or elastomeric coating).

REFERENCES

- A. ASTM International (ASTM)
 - 1. C35, Standard Specification for Inorganic Aggregates for Use in Gypsum Plaster
 - 2. C91, Standard Specification for Masonry Cement
 - 3. C150, Standard Specification for Portland Cement
 - 4. C206, Specification for Finishing Hydrated Lime
 - 5. C207, Specification for Hydrated Lime for Masonry Purposes
 - 6. C897, Standard Specification for Aggregate for Job-Mixed Portland Cement-Based Plasters
 - 7. C926, Standard Specification for Application of Portland Cement-Based Plaster
 - 8. C1063, Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster
- B. Federal Specifications (FS)
 - 1. SS-L-00351a, Type F
- C. Metal Lath/Steel Framing Association (ML/SFA)
- D. American Subcontractor's Association (ASA)
 - 1. No. A42.4
- E. Texas Lathing and Plastering Contractors Association/Texas Bureau for Lath and Plaster
- F. Codes
 - 1. 2018 International Building Codes.

SYSTEM

- A. Design, size and select components, including anchorages to withstand dead, live and wind loads. Wind loads shall be calculated on pressure and suction of wind acting normal to plane as calculated in accordance with the 2018 International Building Code. Design wind speed velocity in accordance with the 2018 International Building Code. Design shall be under the direction and seal of an engineer currently licensed in the State of Texas.
- B. Maximum Allowable Ceiling or Soffit Deflection: L/360

SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Demonstrate coordination with the requirements of cement plaster substrate systems.
- C. Samples: Submit 12 x 12 inch samples of self-furring lath, main beams, cross beams, hanger wire and tie wire.
- D. Certifications: Submit letter from manufacturer(s) that all devices have been designed and tested for the conditions specified. Describe method for securing wind load braces to structure above and to main beams. In lieu of letter from manufacturer, Contractor may submit engineered calculations, sealed by a professional engineer registered in Texas, showing that all specified conditions are satisfied by components proposed to be used on this project.

ACCEPTABLE MANUFACTURERS

- A. Any one (1) of the manufacturers listed who produce equivalent products to those specified is approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements for substitutions in order to be considered.
 - 1. Plaster / Cement Materials:
 - a. ISG Resources, Inc. (Contractor's Option)
 - b. Holcim, Inc.
 - c. Trinity Drywall and Plaster Systems
 - d. TXI Operations Ltd.
 - 2. Furring, Lathing and Accessories:
 - a. Alabama Metal Industries Corp. (AMICO)
 - b. CEMCO
 - c. Clark-Western
 - d. Dietrich Framing Systems
 - e. Western Metal Lath
 - 3. Acrylic Finish Coat: (Walls)
 - a. Dryvit Systems, Inc., West Warwick, RI; (800) 556-7752
 - b. Finestone, Div. of Simplex Products, Jacksonville, FL; (866) 659-3133
 - c. Parex, Inc., Redan, GA; (800) 537-2739
 - d. Rydar, Inc., (Omega Products International, Inc.), Corona, CA; (800) 600-6634
 - e. Senergy, LLC / BASF, Jacksonville, FL; (866) 221-9255
 - f. Sto Finish Systems Div., Sto Corp., Atlanta, GA; (800) 221-2397
 - g. TEC, Div. H. B. Fuller, Palatine, IL; (800) 323-7407
 - h. TEIFS, San Antonio, TX; (800) 358-4785

MATERIALS

- A. Metal lath shall be self-furring diamond mesh type stainless steel having a minimum weight of 3.41 lbs. per sq. yd.
- B. Hanger & Tie Wire:
1. Hanger wire shall be 8 gauge galvanized soft annealed steel wire for tying runner channels to furring members and for hanging runner channels.
 2. Tie wire shall be 16 gauge galvanized soft annealed steel wire for tying cross furring channels to runner channels.
 3. Use 18 gauge galvanized soft annealed steel wire for securing metal lath to metal furring channels, tying lathe laps and securing accessories.
- C. Metal Accessories:
1. Casing beads shall be 24 gauge zinc, No. 66 as manufactured by Penmetal, or equal.
 2. Corner beads shall be 26 gauge zinc, No. 1X as manufactured by Penmetal, or equal.
 3. Expansion joints shall be 26 gauge zinc, No. 40 as manufactured by USG, or equal.
 4. Control joints shall be 26 gauge zinc, No. 75 as manufactured by USG, or equal.
 5. Soffit vents shall be aluminum as manufactured by Fry Corporation. Refer to drawings for specific model numbers.
- D. Metal Channels:
1. Main runner channels, unless noted otherwise, shall be 1 1/2" cold rolled channels weighing a minimum of 475 lbs. per lin. ft., hot dipped galvanized.
 2. Cross furring channels shall be 3/4" cold rolled channels weighing a minimum of 300 lbs. per lin. ft., hot dipped galvanized.
- E. Plaster / Stucco:
1. Mix and install as specified below.

INSTALLATION

- A. Channel erection & lathing:
1. Main channels shall be spaced at 4'-0" o.c. maximum at ceiling plane.
 2. Main runner channels should also be placed at bottom of steel joists above ceiling at 4'-0" o.c. maximum and parallel to ceiling main runners, at exterior ceilings.
 3. Place vertical main runner channels at 4'-0" o.c. maximum between main runners at bottom of steel joists and main runners at ceiling plain to resist uplift of ceilings at exterior ceilings.
 4. Place diagonal main runner channels between vertical runners to stiffen assembly at exterior ceilings.
 5. Cross furring channels shall be spaced at 16" o.c. maximum.
 6. Lathing shall be erected so that finished plaster surfaces shall be true to line, level, plumb, square, etc., without excessive plaster thickness.
 7. Accessories shall be straight, plumb, level, square and true before plaster is applied.
- B. Proportioning and mixing of plaster coats:
1. First (Scratch) coat shall be 3 parts Portland cement, 1 part hydrated lime and 5 parts masonry sand.
 2. Second (Brown) coat shall be 3 parts Portland cement, 1 part hydrated lime and 9 parts masonry sand.

3. Third (Finish) coat shall be 1 part **WHITE** Portland cement, 2 parts lime and 6 parts screened masonry sand.

C. Plaster application:

1. Apply first (Scratch) coat with sufficient material and pressure to form good full keys on metal lathe or good adhesion to masonry or concrete substrates and to cover well, then scratch to roughen surface. Make sure concrete substrates are thoroughly cleaned and all form oils, curing compounds, etc. have been removed.
2. Second (Brown) coat shall be applied after the Scratch coat has set firm and hard, brought to a true and even surface by floating or rodding and left rough and ready to receive finish coat. Dampen the surface of the Scratch coat evenly to obtain uniform suction. Apply Brown coat approximately 3/8" thick in two applications or coats, one immediately following the other.
3. Third (Finish) coat shall be applied when the Brown coat is in a dry and cured condition. Remove any loose and projecting particles from Brown coat, then apply a thin Finish coat well ground into Brown coat and completely covering it. Double back and fill out to a uniform surface approximately 1/8" thick, covering areas in one operation to eliminate jointing. Trowel three or four times before starting to texture. Texture shall be in accordance with sample applied on the job by Plastering Contractor for Architect's approval. Total thickness of all three coats shall not be less than 7/8".

CLEANING UP

- A. Upon completion of the work, remove rubbish, debris, scaffolding and tools and leave spaces beneath and around plaster work broom clean

PROTECTION

- A. Protect Plaster Work from damage by subsequent construction operations.

END OF SECTION 09 21 13

SECTION 09 21 16 – GYPSUM BOARD ASSEMBLIES

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

SUMMARY

- A. Section Includes:
1. Glass Mat Gypsum Board Sheathing.
 2. Gypsum Board, metal framing and joint treatment.
 3. Tile Backer Board.
 4. Metal channel ceiling framing.
 5. Texture finish requirements.

REFERENCE SPECIFICATIONS

- A. The Standard Specifications of the Gypsum Drywall Contractors International (GDCI) and the requirements of ASA No. A97 1 are hereby made part of these specifications. Requirements stated below which may differ from those in the reference specifications shall take precedence.
- B. Component Design: Compute structural properties of studs and joists in accordance with "Specification for Design of Cold-Formed Steel Structural Members" latest edition, as published by the American Iron & Steel Institute (AISI).
- C. Codes and Standards:
1. "Structural Welding Code - Sheet Steel", AWS D1.3 as published by the American Welding Society (AWS).
 2. "Recommended Practices for Resistance Welding Coated Low Carbon Steels", AWS C1.3, as published by the American Welding Society.
 3. 2021 International Building Codes.

GRADES & FINISH OF STEEL

- A. For 16-gage and heavier units, fabricate metal framing components of structural quality steel sheet with a minimum yield point of 50,000 psi and conform to ASTM A 653 and/or A 1011.
- B. For 18-gage and lighter units, fabricate metal framing components of structural quality steel sheet with a minimum yield point of 33,000 psi and conform to ASTM A 653 and/or A 1011.
- C. Provide galvanized finish to all metal framing components complying with ASTM A 653 for minimum G40 coating or having a coating that provides equivalent corrosion resistance. A40 galvanized products are not acceptable.

SUBMITTALS

- A. Product Data: Submit manufacturer's product information and installation instructions for each item of coldformed framing and accessories.
- B. Shop Drawings: Submit shop drawings for all coldform metal framing used to support exterior cladding and used as loadbearing support for any floor or roof areas. Shop drawings shall indicate placing of all framing members showing type, size, gage, number, location and spacing. They shall also indicate supplemental strapping, bracing, splices, bridging, accessories and details required for proper installation. Shop drawings must indicate type of fastening system used along with size and number of fasteners.
1. Welded connections shall show size and length of welds for all components.

2. Screwed connections shall show type, size, and number of screws for all connections. Submit manufacturer's data giving strength values for screws used.

Shop drawings submitted must be prepared under the supervision of and sealed by a registered professional engineer in the state where the project is located. The Engineer of record will not be responsible for coldformed metal framing erected without approved shop drawings.

- C. Calculations: Submit calculations for all coldformed metal framing used to support exterior cladding and used as loadbearing support for any floor or roof areas. Calculations shall indicate sizing of members supporting the loads as indicated on the drawings and design of connections indicating method of connection and,
 1. size and length of all welds for welded connections.
 2. type, size, number and capacity of all screwed connections.

Calculations must be prepared and sealed by a registered engineer in the state where the project is located.

TYPES

- A. Cee "C" Shape Loadbearing and Exterior Cladding Studs:
 1. See Architectural and Structural Drawings .

Subject to compliance with requirements, manufacturers offering Cee "C" shaped, loadbearing steel studs which may be incorporated in the work include, but are not limited to the following:

1. ClarkDietrich Building Systems
2. Bostwick Steel Framing Co.
3. U.S. Gypsum.
4. Wheeling Corrugating Co.
5. Chicago Metallic Corp.

MATERIALS

- A. Gypsum wallboard and ceiling products:
 1. Exterior Glass Mat sheathing shall be
 - a. 1/2" thick, 4'-0" x 8'-0" DensGlass Gold Exterior Guard panels as manufactured by G-P Gypsum or equal.
 2. Interior wall and ceiling board shall be
 - a. 5/8" thick, Gold Bond Type X Fire-Shield, 4'-0"x 8'-0" or 12'-0" panels, with tapered edges as manufactured by National Gypsum or equal.
 3. Interior walls to receive Tile for both wet and non-wet areas shall be
 - a. 5/8" thick, fire rated Type X glass mat faced gypsum Tile Backer, National Gypsum eXP Tile Backer or equal.
 4. Interior walls in wet areas to receive Tile: Cementitious Fiber-Mat Reinforced Panels, 1/2" thick x 32 or 48 inches wide, maximum practical length, square edge
 - a. United State Gypsum Company – Durock or equal.
 5. Acoustical Walls to receive acoustically enhanced 5/8" thick Type X, impact-resistant gypsum board shall be
 - a. National Gypsum – Soundbreak XP or equal.

B. Metal stud and joist framing components:

1. Metal studs or other cold rolled members in all exterior walls shall be sizes as indicated on the drawings and be galvanized sections as specified or scheduled on the structural drawings as manufactured by ClarkDietrich Building Systems, or equal. If not specifically noted or scheduled on structural drawings to the contrary all exterior studs shall be 16 gauge.
2. Metal studs for all suspended furrings at ceilings shall be sizes as indicated on the drawings and be 16 gauge, galvanized members with 2" flanges as manufactured by Unimast Inc., or equal.
3. Metal studs for full height shaft walls, shall be 4" C-H or CT studs, 20 gauge, galvanized members as manufactured by ClarkDietrich Building Systems., or equal.
4. Metal studs in interior walls running full height, and framing walls with ceramic tile finish shall be sizes as indicated on the drawings and be 20 gauge members with 1 3/8" flanges as manufactured by ClarkDietrich Building Systems., or equal.
5. All other metal studs in interior walls shall be sizes as indicated on the drawings and be 25 gauge members with 1 1/4" flanges as manufactured by ClarkDietrich Building Systems, or equal.
6. Header and beam joists and ceiling framing shall be as noted specifically on the drawings or 6", 16 gauge, galvanized members with widest flanges that will fit in width of wall when set side by side as manufactured by ClarkDietrich Building Systems., or equal.
7. Track shall be galvanized deep leg sections in same width and gauge as studs or joists as manufactured by ClarkDietrich Building Systems, or equal.
8. Horizontal wall bridging shall be 1-1/2", 16 gauge, galvanized CRC (cold-rolled channel) sections as manufactured by ClarkDietrich Building Systems., or equal.
9. Screws shall be type "S" self-drilling drywall screws.
10. All other fasteners not specifically noted on the plans shall be weather and corrosion resistant suitable for substrates to which metal members are being attached.

C. Suspended drywall ceiling components:

1. DGL-26 1 1/2" face main tees, heavy duty classification 1 1/2" high x 144" long, integral reversible splice with knurled face and DGLW-424 cross tee sections 1 1/2" high x 48" long as manufactured by USG or equal.
2. DGWM-24 wall molding 1" x 1 1/2" x 144" long, as manufactured by USG or equal.
3. Hanger wire shall be minimum 12 gauge annealed steel, galvanized.
4. Screws shall be type "S" self-drilling drywall screws.

D. Metal hat section ceiling stripping:

1. HW-3100, 22 gauge, 1 1/2" high galvanized hat sections (HS-1) as manufactured by MBCI.

E. Accessories:

1. Corner beads shall be "Dur-a-Bead" no. 103 with 1-1/4" x 1-1/4" flanges as manufactured by United States Gypsum Company, or equal.
2. Casing beads shall be "Sheetrock" series no. 200-A, "J" shaped, channels as manufactured by United States Gypsum Company, or equal.
3. Control joints shall be "Sheetrock", zinc, no. 093 as manufactured by United States Gypsum Company, or equal.
4. Drywall reveals shall be located at all visible areas where gypsum board meets steel tube columns as indicated on drawings. Reveal to be DRMF clear anodized alum finish as manufactured by Fry Reglet Corporation or equal.

F. Sealants:

1. Concealed acoustical sealants shall be rubber based, permanently flexible, non-skinning and non-hardening as manufactured by Tremco, Pecora, Presstite Division of Interchemical Corp., or equal.
2. Exposed acoustical sealants shall be a synthetic resin, paintable compound as manufactured by Tremco, Pecora, Presstite Division of Interchemical Corp., or equal.

INSTALLATION

A. Steel wall framing:

1. Install continuous runners (tracks) at partition heads, bases and wherever partition ends terminate against surfaces of other materials. Secure runners (tracks) to other materials with proper fasteners at 24" o.c. maximum.
2. Install all studs at 16" o.c. maximum, with studs located no more than 2" from ends of all partition runs. Provide double studs (min. 20 gauge) at jambs of all door and window openings.
3. Install a minimum of two horizontal runs of CRC (cold rolled channels) through studs as stiffeners in partitions not exceeding 10'-0" in height. Provide a minimum of three rows of stiffeners in partitions greater than 10'-0" in height.
4. All studs and wallboard shall terminate a minimum of 12" above ceilings. Refer to plans to identify walls and framing which is full height from floor to bottom of structure above.
5. Brace top of non-full height partitions at approximately 45 degrees using stud material to structure above at 4'-0" o.c. maximum and at jamb studs on each side of door frames. Brace full height walls similarly from a point just above the ceiling to the structure above.
6. Fasten suspended ceiling furrings using stud material braced continuous horizontally between structural joists and beams. Do not screw suspended furrings to metal deck above.
7. Install lateral and diagonal racking bracing as per manufacture's recommendations and if noted on drawings.
8. Fastening of all components shall be with self-drilling screws or welding. Screws shall be of sufficient size to insure the strength of the connection. Wire tying of components shall not be permitted. All welds shall be touched up with a zinc-rich paint.

B. Gypsum wall and ceiling board:

1. Install wall board vertically with joints centered over studs. Stagger joints on opposite sides of wall. Attach to studs and floor and ceiling runners with 1" long drywall screws at maximum 8" o.c. along edges of boards and maximum 12" o.c. in the field of the boards. For installation of second layer, install same as described above staggering joints from first layer using 1-5/8" long drywall screws at maximum 8" o.c. along edges of boards and maximum 12" o.c. in the field of the boards. Wall board shall be installed as required for 1 Hr. fire rating.
2. Install ceiling board with long dimension perpendicular to the direction of existing structure. Attach to existing structure same as wall board described above. Existing structure along long edges of panels should fall over solid blocking run between structural members. Ceiling board shall be installed as required for 1 Hr. fire rating.

C. Ceiling suspension systems:

1. Install in accordance with manufacturer's written instructions to assure system will support itself plus gypsum board, light fixtures, diffuses and other ceiling supported items with a maximum allowable deflection of 1/360 of span.
2. Main tees shall be spaced a maximum of 48" on center and supported by hanger wires spaced a maximum 48" on center and as specified by UL Fire Resistance Directory attaching hanger wires directly to structure above. Cross tees shall be spaced per manufacture's recommendations and as specified by UL Fire Resistance Directory.
3. Provide additional hanger wires at all four corners of light fixtures, at the midspan of cross tees adjacent to light fixtures and at the cut end of cross tees longer than 23' which abut the walls.
4. Provide secondary supports (such as unistrut) to span beneath large ducts and suspended equipment to allow the maintaining of maximum hanger wire spacing specified above.

Secondary supports must be hung from building structure above and not from ductwork or equipment. Submit design of secondary supports to maintain maximum allowable deflection of system (1/360 of span) for Architect's approval.

5. Adjust main runner and cross tee spaces as required to accommodate light fixtures, diffusers and other ceiling mounted items. Refer to reflected ceiling plans.

D. Accessories:

1. Install corner beads at all external corners. Corner beads must be screw attached, crimp-on attachment is not acceptable.
2. Install casing beads at all exposed wall or ceiling board edges and at all locations where wall or ceiling board abuts a different material.
3. Install control joints in drywall at no less than 50'-0" o.c., or as shown on plans. Control joints in fire-rated walls, ceilings or assemblies must be designed to maintain the integrity of the fire rating specified and design must be approved by the architect.

E. Sealants:

1. Apply acoustical sealants in accordance with manufacturer's printed instructions at the following locations:
 - a. Serpentine beads under floor track and at ceiling track when abutting other construction.
 - b. Between all gypsum board edges and other materials and building elements.

F. Wood blocking:

1. Install miscellaneous wood blocking to support items requiring secure fastening with in drywall construction.
2. Refer to Section 06 10 00.

SCHEDULES – LEVEL OF FINISH

A. Finishes in accordance with GA-214 Level:

1. Level 1: Embed tape at joints in ceiling plenum areas, concealed areas, on portions of walls above ceilings between the ceilings and the tops of walls and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound rated assemblies.
2. Level 2: Embed tape and apply first coat of joint compound to tape, fasteners, and trim flanges where panels are substrate for tile or behind cabinetry.
3. Level 3: Embed tape and apply separate first and fill coats of joint compound to tape, fasteners, and trim flanges where panels are substrate for medium or heavy textures.
4. Level 4: Embed tape and apply separate first, fill and finish coats of joint compound to tape, fasteners, and trim flanges where panels are substrate for light textures, flat paints or wall coverings.
5. Level 5: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply skim coat of joint compound over entire surface where panels are over 10'-0" high and are substrate for gloss or semi-gloss paints. Walls or ceilings where severe lighting conditions occur (such as perpendicular to windows, storefronts or skylights).
6. Refer to Section 09 90 00 for specific paints specified. Refer to Material Schedule for additional level of finish and/or gloss requirements.

END OF SECTION 09 21 16

SECTION 09 30 00 – TILING

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

SUMMARY

- A. Section Includes:
 - 1. Ceramic Wall Tile.
 - 2. Ceramic Floor Tile.
 - 3. Ceramic Wall Base.
 - 4. Grouted joints.
 - 5. Transition Strips and Accessories.

- B. Related Requirements:
 - 1. Section 03 30 00 – Cast-in-Place Concrete.
 - 2. Section 04 20 00 – Unit Masonry Assemblies.
 - 3. Section 07 92 00 – Joint Sealants.
 - 4. Section 09 21 16 – Gypsum Board Assemblies:.

REFERENCES

- A. American National Standards Institute:
 - 1. ANSI A108/A118/A136.1 - American National Specifications for the Installation of Ceramic Tile.
 - 2. ANSI A137.1 - American National Standards Specifications for Ceramic Tile.

- B. Accessibility:
 - 1. TAS – 2012 Texas Accessibility Standards.
 - 2. 2010 ADA Standards of Accessible Design.

- C. Codes:
 - 1. 2021 International Building Codes.

QUALITY ASSURANCE

- A. Conform to ANSI - American National Standard Specifications for the Installation of Ceramic Tile. ANSI A108 Series/A118 Series/A136.1 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2014.

- B. Conform to TCA (HB) - Handbook for Ceramic Tile Installation; Tile Council of North America, Inc.; 2018.

PERFORMANCE REQUIREMENTS

- A. Dynamic Coefficient of Friction (DCOF) – by DCOF AcuTest, all floor tile shall have a minimum DCOF of 0.42, ANSI A137.1.

SUBMITTALS

- A. Submit actual material samples of all tile and grout products to Architect for approval prior to ordering and/or installing any material.

DELIVERY, STORAGE AND HANDLING

- A. Protect materials from moisture, freezing or overheating in accordance with manufacturer's instructions.
- B. Deliver materials in original unbroken containers bearing the name of manufacturer, brand and grades seals.

MANUFACTURERS

- A. All tile materials shall be quality certified by the Tile Council of America, Inc. to equal or exceed standard grade requirements of AMSI Specification 137.1.1980, packed in sealed containers bearing the certification mark of the TCA.
- B. Tile: Refer to Material and Finish Schedules on Drawings.
- C. Manufacturers of other products listed or required shall be equal to those listed below:
 - 1. Texas Cement Products, Inc., Tex-Rite Custom Building Products.
 - 2. Laticrete International.
 - 3. Mapei Corporation.
 - 4. Schluter Systems.
 - 5. Custom Building Products.
- D. Substitutions: Under provisions of Section 01 25 00.

MATERIALS & INSTALLATION

- A. **TILE FLOORING:** Refer to drawings for color selection, sizes, patterns and locations. Install flooring in accordance with the Tile Council of America's 2018 Installation Handbook, Specification F-122A-17, for thin set tile installation over a waterproofing membrane using latex Portland cement mortar.
 - 1. Install Laticrete 9235 Waterproofing Membrane over concrete sub-floor.
 - 2. Install floor tile on top of Waterproofing Membrane using Laticrete 254 Platinum Multipurpose thin-set mortar.
- B. Waterproofing membrane shall be Laticrete 9235 liquid applied membrane or approved equal. Membrane must be installed in strict accordance with Manufacturer's written instructions for the particular application.
- C. **TILE BASE:** Refer to drawings for color selection, sizes, patterns and locations. Install using same specification as for wall tile.
- D. **WALL TILES:** Refer to drawings for color selection, sizes, patterns and locations.
 - 1. Install Laticrete 9235 Waterproofing Membrane over cementitious backer board.
 - 2. Install ceramic wall tile on top of Waterproofing Membrane using Laticrete 254 Platinum Multipurpose thin-set mortar.
- E. **LATEX MODIFIED GROUT:** Cementitious type, sanded and unsanded, resistant to shrinkage, with latex additive admix; bacteria and mildew resistant. Meets ANSI A118.7
 - 1. Grout joints: are to be thinnest joints per manufacturer's recommended range.

2. Manufacturer and product: Laticrete Grout or equal to all tile. Refer to drawings for Color selection.

F. Once grout has fully cured, install commercial silicone sealant over all grout, at interior walls and floors.

SELF LEVELING UNDERLAYMENT

A. Where Leveling Floor is Required: Level Quick by Custom Building Products. Use with polymer modified, latex primer.

TRANSITION STRIPS

- A. Provide transition strips at wall and floor areas as follows:
1. Provide Schluter Systems RENO-U aluminum transition strip at areas where floor tile meets terrazzo.
 2. Provide Schluter Systems QUADec aluminum transition strip at top of tile wainscot where wall tile meets gypsum board.

CLEANING & PROTECTION

- A. Upon completion of grouting work thoroughly clean all grout film from tile surfaces. After grout has fully cured, apply sealer as specified above.
- B. Protect floor tile by covering or controlling traffic until work by other trades is complete.

GUARANTEE

A. Furnish a written guarantee from the installer that all work performed under this section shall be free from defects in material and workmanship for a period of 1 year from the date of substantial completion of the project.

END OF SECTION 09 30 00

SECTION 09 51 13 – ACOUSTICAL PANEL CEILINGS

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

GENERAL

- A. All suspended ceiling systems shall be warranted for one (1) year against becoming unserviceable or objectionable in appearance as a result of being defective or non-conforming. Without limiting the warranty scope, the work shall be warranted against:
1. Noticeable sagging of the tile or board.
 2. Discoloration, darkening, mildewing of tile, board or exposed metal parts.
 3. Rusting or corrosion of the suspension system.
 4. Gaps in the tile or board caused by loose or improperly sized units.

SUBMITTALS

- A. Furnish one unit of each type of ceiling tile or board along with samples of each type of suspension system.

PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original, unopened, protective packaging, with manufacturer's labels indicating brand name, pattern, size, thickness and fire rating, legible and intact.
- B. Store materials in original protective packaging to prevent soiling, physical damage or wetting.
- C. Store cartons open at each end to stabilize moisture content and temperature.
- D. Do not begin installation until sufficient materials to complete a room are received.

ENVIRONMENTAL REQUIREMENTS

- A. Complete installation of dampening materials before beginning Work.
- B. Do not install acoustical ceilings until exterior openings have been closed and the roofs are watertight. Temperature and relative humidity in the installation areas shall have reached levels which comply with the acoustical material manufacturer's recommendations before beginning work.
- C. Maintain temperature and relative humidity levels in the installation areas within the acoustical material manufacturer's recommended range during and after installation until acceptance by the Owner.

MATERIALS

- A. Suspension system shall be non-fire rated, Prelude XL 15/16", heavy duty, Exposed Tee System, 24" x 24" in white finish as manufactured by Armstrong or equal.
- B. Ceiling panels shall be 24" x 24" x 5/8", Rockfon Artic, SL square edged tegular, 660 white finish as manufactured by Rockfon or equal.

- C. Provide hold-down clips at all ceiling panels.

ABOVE CEILING INSPECTION

- A. Examine surfaces scheduled to receive suspended units for irregularities and dampness that would affect quality and execution of Work. Deficiencies must be corrected before contractor installs ceiling.
- B. Mark access provisions at locations where indicated by the Mechanical Subcontractor before beginning installation.
- C. As a minimum, the following shall be in place before observation is scheduled:
 - 1. Minimum of 80% of light fixtures installed and functioning.
 - 2. Piped systems installed and insulation completed; leak and pressure tests performed and acceptable.
 - 3. Pipe painting and identification complete.
 - 4. Rigid and flexible ducts completed and insulated.
 - 5. Air devices installed and connected.
 - 6. Control air tubing installed.

WORKMANSHIP

- A. Coordinate and schedule the work with adjoining work provided under other sections of the specifications. Do not close ceilings until all work above ceilings is complete.
- B. Examine the job conditions affecting acoustical installation and report to the Contractor any deficiencies that will prevent proper installation of acoustical work. Do not start installation until such deficiencies have been corrected.
- C. Installation shall conform to the drawings, the applicable specifications of the Acoustical Materials Association, the manufacturer's written instructions and the requirements herein.
- D. The suspension systems shall support the ceiling assemblies shown on the drawings, including lighting fixtures, diffusers, grilles and similar items in the assemblies, with a maximum allowable deflection of 1/360 of span.
- E. Provide secondary supports (such as unistrut) to span beneath large ducts and suspended equipment to allow the maintaining of maximum hanger wire spacing as recommended by the manufacturer. Secondary supports must be hung from the structure above and not from ductwork or equipment. Submit design of secondary supports to maintain maximum allowable deflection of system (1/360 of span) for Architect's approval.
- F. Layout the work in conformance with the reflected ceiling plan. Center patterns in spaces and conform to building modules as indicated. Layout shall provide greatest possible width of perimeter units, with widths being equal at opposite sides of the spaces. Uniform patterns for ceiling units, lighting fixtures, diffusers and grilles shall be provided through cooperation with other installing trades.

- G. Completed ceilings shall be level, true to plane, pattern and module and square with the walls. Joints in tile, board and exposed suspension members shall be parallel and true. Ceiling work shall fit closely to adjoining items and construction, and be free from damaged tile and trim.
- H. Before final inspection and acceptance of the work, clean soil marks from ceilings, replace damaged units, touch-up abrasions on exposed metal with matching paint, and make any necessary adjustments to the systems. Leave the work clean, true to design and free from defects.

CLEANING

- A. Clean soiled or discolored unit surfaces after installation.
- B. Touch up scratches, abrasions, voids and other defects in painted surfaces.
- C. Remove and replace damaged, or improperly installed units.
- D. Clean exposed surfaces of grid members and panels, including trim and edge moldings. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and bent units.

END OF SECTION 09 51 13

SECTION 09 65 13 – RESILIENT WALL BASE

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Resilient Wall Base.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of product indicated.
- C. Samples for Verification: For each type of product indicated, in manufacturer's standard-size samples of each resilient product color, texture, and pattern required.
- D. Product Schedule: For resilient products. Use same designations indicated on Drawings.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 85 deg F (29 deg C).

1.5 PROJECT CONDITIONS

- A. Install resilient products after other finishing operations, including painting, have been completed.
- B. Maintain ambient temperatures within range recommended by manufacturer, but not less than 65 deg F (18 deg C) or more than 85 deg F (29 deg C) in spaces to receive resilient products during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- C. Maintain the ambient relative humidity between 40% and 60% during installation.

- D. Until Substantial Completion, maintain ambient temperatures within range recommended by Roppe, but not less than 55 deg F (13 deg C) or more than 85 deg F (29 deg C).

PART 2 - PRODUCTS

2.1 RESILIENT WALL BASE

Manufacturer:

Johnsonite, Inc.	Phone	(800) 899-8916
16910 Munn Road		(440) 543-8916
Chagrin Falls, Ohio 44023	Tech:	Ext 9297
Web: www.tarkettna.com	Samples:	Ext 9299
E-mail: info@johnsonite.com	Fax:	(440) 543-8920

A. STANDARD RESILIENT WALL BASE

Traditional Rubber Cove Base – .080" (2.0mm) thick by 4" height wall base, 120' coils, Color shall be as indicated on drawings.

2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland cement based formulation manufactured and warranted by a reputable manufacturer.
- B. Adhesives: as recommended by Johnsonite to meet site conditions
 1. Johnsonite #960 Cove Base Adhesive (Porous applications)
 2. Johnsonite #946 Premium Contact Bond Adhesive (Non-porous applications)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient wall base.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

- C. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- D. Vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- E. Do not stretch resilient base during installation.
- F. Preformed corners: Install preformed corners if available before installing straight pieces.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- B. Perform the following operations immediately after completing resilient product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Damp-mop surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

END OF SECTION 09 65 13

SECTION 09 65 16 – COMMERCIAL VINYL FLOORING

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

PART 1 GENERAL

1.1 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM F 1700 - Standard Specification for Solid Vinyl Floor Tile.

1.2 SUBMITTALS

- A. Product Data: Provide detailed data on each product to be used including but not limited to the following information as applicable:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Maintenance recommendations.
- B. Verification Samples: For each finish product specified, two sets of each type, colors and finish of resilient flooring and accessory required, indicating color and pattern of actual product, including variations, as proof of application compliance.
- C. Closeout Submittals: Submit three copies of the following:
 - 1. Maintenance and operation data includes - methods for maintaining installed products, and precautions against cleaning materials and methods detrimental to finishes and performance.
 - 2. Documentation of warranty specified herein.
- D. Flame Spread Certification: Submit manufacturer's certification that resilient flooring furnished for areas indicated to comply with required flame spread rating has been tested and meets or exceeds indicated or required standard.

1.3 QUALITY ASSURANCE

- A. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - 1. Finish areas designated by Architect.
 - 2. Do not proceed with remaining work until workmanship, color, sheen and finished appearance are approved by Architect.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Flooring material and adhesive shall be acclimated to the installation area for a minimum of 48 hours prior to installation.
- C. Store cartons of tile products flat and squarely on top of one another, not on edge.

1.5 PROJECT CONDITIONS

- A. Environmental Requirements/Conditions: In accordance with manufacturer's

recommendations. Areas to receive flooring shall be clean, fully enclosed, weather tight with the permanent HVAC set at a uniform temperature of at least 65 degrees F (18 degrees C) and less than 85 degrees (30 degrees C) 48 hours prior to and during and for not less than 48 hours after installation. The flooring material shall be conditioned in the same manner prior to installation.

- B. Close spaces to traffic during resilient flooring installation and for a period of time after installation as recommended in writing by the manufacturer.
- C. Install resilient flooring materials and accessories after other finishing operations, including painting, have been completed.
- D. Where demountable partitions and other items are indicated for installation on top of sheet resilient flooring material, install flooring material before these items are to be installed.
- E. Concrete substrates should not exceed 82 percent RH and/or 6 lbs. X 24 hrs. X 1000 sf. moisture vapor emissions rate tested in accordance to ASTM F 2170 and ASTM F 1869.

1.6 WARRANTY

- A. Warranty Period: Manufacturer's standard warranty against manufacturing defects and wearing for flooring and as follows:
 - 1. Patcraft:
 - a. 15 Year Commercial Limited Warranty.

1.7 EXTRA MATERIALS

- A. Deliver to Owner extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Division 1 closeout submittals requirements.
 - 1. Quantity: Furnish quantity of flooring units equal to 2 percent of amount installed. Comply with Owner's requirements for delivery, storage and protection of extra materials.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Patcraft, a brand of Shaw Industries Group, P.O. Box 2128, Dalton, GA, 30722. (800) 241-4014.

Web: www.patcraft.com
- B. Substitutions: Permitted.
- C. Requests for substitutions will be considered in accordance with provisions of Section 01 25 00 Substitution Procedures.

2.2 GLUE DOWN LVT

- A. Glue Down LVT:
 - 1. Style: Refer to Material Schedule

2. Style Number: Refer to Material Schedule
3. Color: Refer to Material Schedule
4. Product Type: Glue Down LVT
5. Overall Thickness: 0.197"(5mm)
6. Wear Layer Thickness: 20 mil (0.508 mm).
7. Edge Profile: Squared Edge
8. Finish: Exoguard.
9. Size: Refer to Material Schedule
10. Construction: Commercial Grade Luxury Vinyl Tile
11. Installation: Glue Down
12. Classification: ASTM F1700-Class III, Type A-Smooth, Type B-Embossed

2.3 ACCESSORIES

- A. Adhesive: Manufacturer's recommended adhesive as follows.
 1. LokWorx 4200 Resilient Adhesive
 2. LokWorx 2200 Resilient Adhesive
 3. LokWorx 4252 Resilient Adhesive
- B. Portland based cementitious base leveler. Gypsum based not acceptable.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Inspect floor to be installed immediately upon arriving at job site; perform a moisture test.
- B. Do not begin installation until substrates have been properly prepared.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- D. The installation of the resilient flooring shall not begin until the work of all other trades has been completed, particularly wet and overhead trades.
- E. Areas to receive flooring shall be adequately lighted during all phases of the installation process.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Using Portland based cementitious base leveler fill and cover all seams, nail heads, voids, cracks, and expansion joints. Achieve smooth, even, firmly attached substrate for best finish results.
 1. Float with a Portland cement compound using a latex additive (as recommended by the manufacturer) instead of water.
 2. Once substrate levelness is achieved continue with the next step.
- C. Apply concrete floor sealer to substrate in accordance with manufacturer's recommendations.
- D. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

- E. Concrete Substrates: The Contractor shall verify to the Owner and installer a minimum of 30 days prior to the scheduled resilient flooring installation the following substrate conditions. All substrate testing shall be documented and submitted to the Architect and Owner before commencement of the flooring installation.
1. Verify that substrates are dry, free of debris, and that all curing compounds, sealers, and hardeners have properly cured.
 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
 4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.

3.3 INSTALLING RESILIENT TILES AND PLANKS

- A. General:
1. Permanent HVAC system shall be turned on and set to a minimum of 65 degrees F (20 degrees C) for a minimum of 48 hours prior to, during and 48 hours after installation. After the installations, the maximum temperature should not exceed 125 degrees F (37 degrees C).
 2. All products must be allowed to acclimate at least 24 to 48 hours before installation. This means product must be placed in the same room as the install that is taking place and removed from its factory packaging.
 3. Material shall be visually inspected prior to installation.
 4. Ensure that all recommendations for sub-floor and jobsite conditions are met prior to beginning the installation. Once the installation is started, Contractor and installer have accepted those conditions.
 5. Install in accordance with manufacturer's installation instructions for each product type and application specified.
- B. Layout and Installation:
1. Center tiles or planks in rooms and hallways so borders are not less than half a tile or plank when possible.
 2. Cut edges shall always be installed against a wall.
 3. Install using tile and plank installation techniques recommended by manufacturer.
 4. Install tiles, planks, borders and feature strips in locations and configurations indicated on the Drawings.
- C. Adhesive Application:
1. Any spread glue has to be covered with material and rolled within the recommended time frame described on the adhesive container.
 2. If troweled adhesive skims over, scrape up and reapply.
 3. Install in accordance with adhesive manufacturer's recommendations.
 4. Refer to manufacturer's literature for selection criteria for trowel size, type.
 5. Using proper trowel size, apply adhesive in accordance with label on adhesive.
 6. Spread a 4 inch (100 mm) wide band of adhesive around the perimeter of the area designated as an extreme condition area.
 7. An additional 4 inch (100 mm) band should be spread at approximately 10 foot (3 m) intervals.
 8. For transitional areas, from loose lay to another floor covering of a different height, a 4 inch (100 mm) band of adhesive should be spread across the length of the

transition.

3.4 CLEANING

- A. Wipe off any adhesive on floor as installation proceeds. Wait 48 hours before applying the cleaning and maintenance products.
- B. Prior to installation of permanent fixtures or furniture, remove all dirt, debris, or residual adhesive and clean the floor. If desired, a protective coating may be applied at this time. Specific products and instructions are available from the manufacturer.

3.5 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

3.6 MAINTENANCE

- A. Comply with manufacturers instructions for proper cleaning and maintenance of the products.

END OF SECTION 09 65 16

SECTION 09 66 00 – TERRAZZO FLOORING

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes resinous matrix terrazzo floor and base and divider strips.

1.2 RELATED SECTIONS

A. Section 03 30 00 – Cast-In-Place Concrete: Concrete subfloor with trowel finish.

B. Section 07 92 00 – Joint Sealants: Joint between terrazzo and wall surface.

1.3 REFERENCES

A. ASTM International:

1. ASTM C150 - Standard Specification for Portland Cement.

B. National Terrazzo and Mosaic Association:

1. NTMA - Terrazzo Specifications Guide.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittals: Submittal procedures.

B. Shop Drawings: Indicate divider strip and control joint layout, flooring material transitions, color patterns, and details of adjacent components.

C. Product Data: Submit data for divider strips and sealer.

D. Samples: Submit two samples, minimum 8x8 inches in size for each system type and color illustrating color, chip size and variation, chip gradation, matrix color and typical divider strip.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 77 00 - Closeout Procedures: Closeout procedures.

B. Operation and Maintenance Data: Submit procedures for stain removal, stripping, and sealing and general maintenance.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with NTMA recommendations contained in "Terrazzo Information Guide".

B. Acceptable Flooring Manufacturer: An Associate Member of the NTMA, experienced in manufacturing products specified in this section in accordance with NTMA standards and with a record of successful in-service performance as well as sufficient production capacity to produce required materials

C. Acceptable Terrazzo Contractor: A Contractor Member of NTMA whose work has resulted in construction with a record of successful in-service performance.

1. Installer shall have completed terrazzo installations within the past 5 years of scale and complexity similar to the proposed installation
- D. Terrazzo Standards: Terrazzo Contractor shall furnish materials and install terrazzo according to NTMA's "Terrazzo Specifications and Design Guide" and with written recommendations for terrazzo type indicated unless more stringent requirements are specified.
- E. Source Limitations for Aggregates: Terrazzo Contractor shall obtain each color, grade, type and variety of granular materials from sources with resources to provide materials of consistent quality in appearance and physical properties.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store resin materials in dry, secure area.
- B. Maintain minimum temperature of 60 degrees F and maximum of 90 degrees.
- C. Keep products away from fire or open flame.
- D. Materials shall be delivered to Project site in supplier's original wrappings and containers, labeled with source or manufacturer's name, material or product brand name, and lot number if any.
- E. Materials shall be stored in their original, undamaged packages and containers, in a location where they will not be exposed to direct sunlight

1.8 ENVIRONMENTAL CONDITIONS

- A. Do not install terrazzo when temperature is below 60 degrees F or above 90 degrees.
- B. General Contractor shall provide sufficient water, temporary heat and light, and adequate electric power with suitable outlets connected and distributed for use within 100 feet of any working space.
- C. General Contractor shall provide temporary enclosures and other suitable methods to protect adjacent spaces from damage during installation.
- D. Terrazzo Contractor shall protect other adjacent work from water and dust generated by grinding operations.

1.9 COORDINATION

- A. Coordinate placement of terrazzo divider strips with location of mechanical and electrical access covers, floor mat frames, and other items built in to terrazzo.

PART 2 - PRODUCTS

2.1 RESINOUS MATRIX TERRAZZO

- A. Manufacturers:
 1. American Terrazzo Company Garland, Texas, 972.272.8084, www.americanterrazzo.com.

2. Southern Tile & Terrazzo Co., 713-649-2434, mmaraldo@southerntileterrazzo.com (Basis Of Design)
 3. Substitutions: Under provisions of Section 01 25 00.
- B. Epoxy Resin matrix with aggregates to a minimum thickness of 3/8 inches.
1. Epoxy Resin:
 - a. Test Specimens: Mix resin materials according to manufacturer's recommendation without aggregate added and cure for 7 days at 75 degrees plus or minus 2 deg. F and 50 percent plus / minus 2 percent relative humidity.
 - b. Cured test specimens shall meet or exceed the following requirements:
 - 1) Hardness: 60 to 85 per ASTM D2240, Shore D.
 - 2) Minimum Tensile Strength: 3000 psi per ASTM D638 for a 2-inch specimen made using a "C" die per ASTM D412.
 - 3) Minimum Compressive Strength: 10,000 psi per ASTM D695, Specimen B cylinder.
 - 4) Chemical Resistance: No deleterious effects by contaminants listed below after seven-day immersion at room temperature per ASTM D1308.
 - a) Distilled Water.
 - b) Mineral Water.
 - c) Isopropanol.
 - d) Ethanol.
 - e) Soap solution at 1 percent.
 - f) Sodium hydroxide at 10 percent solution.
 - g) Hydrochloric acid at 10 percent solution.
 - h) Hydrochloric acid at 30 percent solution.
 - i) Detergent Solution at 0.025.
 - j) Acetic Acid at 5 percent solution.
 2. Epoxy Resin with Aggregate:
 - a. Test Specimens:
 - 1) Mix epoxy resin according to manufacturer's recommendations and blend one volume of epoxy resin with 3 volumes of marble aggregate, consisting of:
 - a) 70 percent No. 1 chip.
 - b) 30 percent No. 0 chip.
 - 2) Grind and grout with epoxy resin finished to a nominal 1/4 inch thickness.
 - 3) Cure specimens 7 days at 75 deg. F plus / minus 2 deg. and 50 percent plus / minus 2 percent relative humidity.
 - b. Cured epoxy terrazzo specimens shall nominally meet the following requirements:
 - 1) Flammability: Self- extinguishing, extent of burning 1/4 inch maximum according to ASTM D635.
 - 2) Coefficient of Linear Thermal Expansion: 0.000025 inch/inch per degree F per ASTM C531.
- C. Bond Strength of Epoxy Terrazzo: 300 lb. failure according to field test method for surface soundness and adhesion as described in ACI Committee No. 403 Bulletin.

2.2 COMPONENTS

- A. Epoxy Matrix: Two component resin and epoxy hardener with mineral filler and color pigment, non-volatile, thermo-setting.
1. Color: As selected, reference Material Schedule.
- B. Primer: As recommended, manufactured and supplied by epoxy resin manufacturer.

- C. Aggregates: Marble, glass.
 - 1. Comply with NTMA gradation standards.
 - 2. Abrasion and Impact Resistance: Loss of 40 percent or less when tested according to ASTM C131 (LA Abrasion).
 - 3. Aggregates shall contain no deleterious or foreign matter.
 - 4. Glass not exceed 10% of mix.

2.3 ACCESSORIES

- A. Divider Strips: Material: White alloy of zinc or aluminum, as selected; 16 gauge; "L" shaped 3/8 inch by 1/2 inch.
- B. Control Joint Strips: Same material as divider strips wide 1/4 inch neoprene filler strip between vertical two "L" strips, with anchoring features.
- C. Strip Height: To suit thickness of terrazzo topping, with allowance for grinding.
- D. Sealer: Colorless, non-yellowing, penetrating liquid type to completely seal matrix surface; not detrimental to terrazzo components.
- E. Crack Suppression/Isolation Membrane: Anti-Fracture membrane with impregnated mesh as recommended and supplied by approved terrazzo resin formulator, having minimum 120 percent elongation potential per ASTM D412.
- G. Moisture mitigation system is to be installed by terrazzo contractor to suppress moisture.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify substrate surfaces are ready to receive work.
- B. Do not begin terrazzo work until concrete substrate has cured 28 days, minimum, and substrate has dried to maximum moisture content of 12 percent.

3.2 PREPARATION

- A. Clean substrate of foreign matter.

3.3 INSTALLATION

- A. Saw cut substrate to install divider and control joint strips.
- B. Install divider and control joint strips straight and level to locations indicated.
- C. Install border, divider and control joint strips to match floor pattern as indicated on drawings.
- D. Place terrazzo mix over prepared substrate to thickness 3/8" to 1/2" before grinding.
- F. Close area to allow undisturbed curing.

G. Finishing:

1. Finish terrazzo to NTMA requirements.
2. Produce terrazzo finish surface to match approved sample.
3. Grind terrazzo surfaces with power disc machine; sequence with coarse to fine grit abrasive, using wet or dry method.
4. Apply patch mix to match mortar over ground surface to fill honeycomb exposed during grinding.
5. Remove patch coat by grinding, using fine grit abrasive.

3.4 ERECTION TOLERANCES

- A. Section 01 45 00 - Quality Control: Tolerances.
- B. Maximum Variation from Flat Surface: 1/8 inch in 10 feet.
- C. Maximum Variation from Level (Except Surfaces Sloping to Drain): 1/8 inch

3.5 CLEANING

- A. Scrub and clean terrazzo surfaces with cleaner. Let dry.
- B. Immediately after terrazzo has dried, apply sealer.
- C. Seal and polish surfaces.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Do not permit traffic over finished terrazzo surfaces.

END OF SECTION 09 66 00

SECTION 09 68 13 – MODULAR FLOORING

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

GENERAL

- A. Section Includes:
1. Carpet modules as shown on the drawings and schedules and as indicated by the requirements of this section.
 2. The installation shall include all floor preparation, including measurement.

RELATED SECTIONS

- A. Other Division 9 sections for floor finishes related to this section but not the work of this section.
B. Division 3 Concrete - not included work this section.
C. Division 6 Wood and Plastics - not included work this section.
D. Division 7 Thermal and Moisture Protection - not included work this section.

QUALITY ASSURANCE

- A. Qualifications of flooring installation contractor: All work shall be done by installation firms specializing in commercial flooring and carpet installation. It is required, that the firm or individual shall be a member of the Floor Covering Installation Contractors Association (FCICA) and/or certified by the Certified Floorcovering Installers Association (CFI). Flooring contractor to be specialty contractor normally engaged in this type of work and shall have three (3) years minimum documented experience in commercial installation of similar flooring materials and participation in manufacturer's environmental program including responsible flooring removal, recycling, and installation.
- B. Flooring contractor will be responsible for the proper product installation, including floor preparation in all the areas indicated in the drawings to receive carpet modules. The installation standard will be as listed in Manufacturer's Installation Instructions.
- C. Flooring contractor to provide owner a written warranty that guarantees the completed installation to be free from defects in materials and workmanship for a period of no less than two (2) years after job completion.
- D. Manufacturer qualifications: Manufacturing facility to ISO 14001 certified and have a minimum of 10 years experience in the manufacture of commercial flooring.
- E. Manufacturer to provide field service experts to assist in project start-up as required by the job and will notify owner, architect, general contractor, or another designated contact if any installation instructions are not followed.

SUBMITTALS

- A. Submit to architect two (2) 12" x 12" (minimum size) finished samples of the exact type of flooring proposed, including quality, pattern, color and backing.

- B. Submit to architect and/or owner ten (10) days before bid, any proposed substitutions for consideration. Submit at least three (3) references of installations using the same flooring technology, as described within this text. Include contact names and telephone numbers.
- C. Submit manufacturer's warranties, installation instructions, and maintenance instructions.

DELIVERY, STORAGE AND HANDLING

- A. Deliver all materials to the installation site in the manufacturer's original packaging and in good condition. Packaging to contain manufacturer's name and marks, identification number, shipping and handling instructions and related information.
- B. Delivered and stored materials must be available for inspection as required by the owner, architect, general contractor and/or the manufacturer.
- C. All materials, including adhesives, are to be delivered to the site of installation at a minimum of 48 hours prior to the start of installation and stored in a clean and dry room. The floor and room temperature must be acclimated by maintaining the temperature between 65°F and 85°F, and the humidity between 30% and 65%, for at least 48 hours before and during installation. In addition, the carpet and adhesive should be stored under these conditions for at least 24 hours before installation. The installation site must be acclimated with controlled temperature and humidity.
- D. Once the temperature and relative humidity in area for installation have been stabilized, loose lay the modules within the installation area and allow them to precondition for 48 hours prior to installation. Module installation shall not commence until painting and finishing work is complete and ceiling and overhead work is tested, approved and completed. Traffic shall be closed during the installation of the textile composite flooring products. Verify concrete slabs are dry per the standards for bond and moisture tests listed in the manufacturer's installation instructions.

SUBSTITUTIONS

- A. All Bid submittals must conform to the specifications in this document.
- B. All test results to be in accordance with a certified independent testing laboratory.

PRODUCTS

MANUFACTURER

- A. Acceptable Manufacturer: Patcraft, a brand of Shaw Industries Group, P.O. Box 2128, Dalton, GA, 30722. (800) 241-4014. Patcraft.com.

MATERIALS

- A. Organic Interuption flooring modules (tiles):
 1. Product: Walk Right In II
 2. Style: I0304
 3. Color: as indicated on drawings
 4. Standard Size: 24 x 24 inch modules
 5. Backing: EcoWorx Tile

6. Installation Method: Quarter Turn

ADHESIVES

- A. Provide adhesive as recommended by manufacturer.
- B. Ensure the proper amount of adhesive is applied to the sub-floor. Prior to installation, mark off a small area of the sub-floor and determine the adhesive spread rate.

EXECUTION

INSPECTION

- A. Examine and verify that sub-floor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive installation of modules.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive installation of modules.
- C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to sub-floor surfaces.
- D. Verify that concrete sub-floor surfaces are dry enough and ready for flooring installation by testing for moisture emission rate and alkalinity in accordance with ASTM F 710.
- E. Verify that required floor-mounted utilities are in correct location.

PREPARATION

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. SURFACE PREPARATION- Substrate with excessive dust must be leaned and then primed with a product such as PrimeCoat to ensure proper bonding.
- C. CONCRETE MOISTURE TESTING and pH TESTING – Concrete slabs must be tested for moisture by the current version of ASTM F2170. (Consult CRI 104 part 6.2 for standard test method for determining relative humidity on concrete floor slabs using In-Situ Probes.) Below are the requirements:
 - 1. If reading is below 90% RH, EnPress or FlexLok tabs
 - 2. If reading is between 90-95% RH, OptiSeal or FlexLok tabs are required.
 - 3. If reading exceeds 95% RH, and no signs of visible moisture are present, Mohawk FlexLok tabs are an acceptable alternative solution to other moisture mitigation solutions. For thorough guidelines regarding site conditions, floor prep and installation consult the complete set of FlexLok installation instructions.
 - 4. If pH is between 10-11, Optiseal is required
 - 5. Mohawk FlexLok tabs are acceptable solution for pH between 10-12. For thorough guidelines regarding site conditions, floor prep and installation, consult the complete set of FlexLok installation instructions.

SUBFLOORS

- F. New Concrete - New concrete must be fully cured and free of moisture (see ASTM F 710). New concrete requires a curing period of approximately 90 days. Prime if floor is extremely porous or has excessive dust. Note: Any existing sealer or primer must be tested for compatibility with Mohawk Group's adhesive.

INSTALLATION

- A. Install flooring in strict accordance with the finish drawings and Manufacturer's installation instructions.
- F. Capret should be protected from heavy traffic and construction dust with non-staining, building material paper. Never use plastic sheeting as it will trap moisture and prevent proper curing of the adhesive.

INSTALLATION OF ACCESSORIES

- A. Install accessories as required by drawings and per manufacturer's specifications.

CLEANING AND PROTECTION

- A. Use a moist cloth when wet; if dry, use a solvent based product applied to a towel then worked onto the carpet module for removal of contaminants such as adhesive, paint, oil and grease. Follow manufacturer's maintenance guidelines.
- B. Clean and vacuum surfaces.

END OF SECTION 09 68 13

SECTION 09 84 14 – ACOUSTIC STRETCHED FABRIC SYSTEMS

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

GENERAL

- A. Section Includes:
 - 1. Acoustic Stretched Fabric Wall Systems
 - 2. Acoustic Stretched Fabric Ceiling Systems
- B. Related Work:
 - 1. Section 09 26 16 – Gypsum Board Assemblies
 - 2. Section 09 51 13 – Acoustical Panel Ceilings

SUBMITTALS

- A. Product Data: Submit manufacturer's product data including certified laboratory test reports and other data required to show compliance with these specifications.
- B. Samples: Submit 9" x 11" samples of representative panel with factory detailed edge, and representative samples of mounting devices.

QUALITY ASSURANCE

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

DELIVERY, STORAGE AND HANDLING

- A. Project Conditions: Protect system components from excessive moisture in shipment, storage, and handling. Deliver in unopened bundles and store in a dry place with adequate air circulation. Do not deliver material to building until wet conditions such as concrete, plaster, paint, and adhesives have been completed and cured.

WARRANTY

- A. Provide manufacturer's standard limited 3-year warranty against manufacturing defects in material or workmanship.

WALL PANELS

- A. Basis-of-Design: Conwed Eurospan System. Reference Material Schedule for finish, thickness and type.
 - 1. Construction: Comprised of three basic components: a fiberglass acoustic core, perimeter tension track, and outer textile covering.
 - 2. Fiberglass Density: 6-7 pcf.
 - 3. Cores Thickness: Standard 1 inch.
 - 4. Width: Max of 16 feet and custom. Refer to Drawings.
 - 5. Length: Custom. Refer to Drawings.
 - 6. Corners: Square

- 7: Edge Profile: Square
8. Fabric Finish: As indicated on drawings.
9. Mounting Type: Square perimeter track and square mid joint track.
10. Flammability (ASTM E 84): System shall have a Class "A" rating per ASTM E 84.
11. Resistivity to Heat or Cold: R-factor of 4.16 per inch thickness
12. Acoustical Performance: Values below are for panels mounted in accordance with ASTM C 423 (Type A Mounting) and vary by panel thickness and finish.
 - a. Noise Reduction Coefficient (NRC) for 1 inch thickness: 0.90.

CEILING PANELS

- A. Basis-of-Design: Conwed Eurospan System. Reference Material Schedule for finish, thickness and type.
1. Construction: Comprised of three basic components: a fiberglass acoustic core, perimeter tension track, and outer textile covering.
 2. Fiberglass Density: 3 pcf.
 3. Cores Thickness: Custom 2 inches.
 4. Width: Max of 16 feet and custom. Refer to Drawings.
 8. Length: Custom. Refer to Drawings.
 9. Corners: Square
 - 10: Edge Profile: Square
 12. Fabric Finish: As indicated on drawings.
 13. Mounting Type: Square perimeter track and square mid joint track. Furring strips as required.
 14. Flammability (ASTM E 84): System shall have a Class "A" rating per ASTM E 84.
 15. Resistivity to Heat or Cold: R-factor of 4.16 per inch thickness
 16. Acoustical Performance: Values below are for panels mounted in accordance with ASTM C 423 (Type A Mounting) and vary by panel thickness and finish.
 - a. Noise Reduction Coefficient (NRC) for 2 inch thickness: 1.0.

INSTALLATION

- A. Verify wet work such as plastering and concrete is complete and dry. Verify building is enclosed and under standard occupancy conditions (60-85 degrees F and not more than 70 percent relative humidity) prior to start of installation. Commencement of installation constitutes Installer's acceptance of surfaces and conditions.
- B. Install products in accordance with manufacturer's written instructions and in proper relationship with adjacent construction, including the following:
1. For adhesive installation to substrate, provide temporary support to prevent panel slippage.
Note: Impaling clips are designed to help hold panels in place until adhesive dries.
- C. Touch-up, repair or replace damaged units until satisfactory results are obtained.

END OF SECTION 09 84 10

SECTION 09 90 00 – PAINTING AND COATING

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

SCOPE

- A. Refer to Finish Plan, Interior Elevations, Material Schedules, and notes on the drawings , Section 6 and this Section of the specifications to determine building surfaces to be painted or otherwise finished.

WARRANTY

- A. All painting and caulking shall be warranted for 2 years against becoming unserviceable or objectionable in appearance as a result of being defective or non-conforming. Without limiting the warranty scope, the work in general shall be warranted not to:
1. Noticeably discolor, yellow, streak, bloom, bleak, darken or fade.
 2. Change sheen with excessive speed or irregularity.
 3. Peel, crack, blister or alligator.
 4. Release from the substrate or intermediate coats.
 5. Chalk or dust excessively.
 6. Stay tacky or become tacky.
 7. Mildew

SUBMITTALS

- A. Samples:
1. Submit three paper chip samples, 8 1/2" by 11" in size, illustrating range of colors available for each surface finish product as scheduled.
 2. Colors shall be in accordance with furnished schedules. Provide samples of every color and finish required.
 3. Prepare at project site on a material similar in texture to that which it is to be applied.
- B. Submit technical data sheets describing properties and application recommendations from manufacturers providing materials on the project.
1. Manufacturer's printed VOC data.
- C. Provide actual samples of stained work prepared by painting contractor on pieces of actual wood to be used on the project obtained from millwork supplier.

SCHEDULE

- A. Based upon submittals, the Architect will prepare a paint and finish schedule identifying all materials and colors to be used on the project.

MATERIALS

- A. The bid shall be based upon all paint, enamel, latex, fillers, thinners and other materials listed in the following schedule.
- B. Thinners shall only be those recommended by the particular paint manufacturer for use with his products.

- C. Use proper colored bases to mix colored paints. Prime coats shall be colored nearly the same as finish coats.
- D. The Architect reserves the right to select a different color for each room or space and to have colors adjusted at any time before the final coat is applied.
- E. Refer to Section 01 60 00 – Extra Stock.

ACCEPTABLE MANUFACTURERS

- A. Best grade commercial products of the following manufacturers will be acceptable for use on the project.
 - 1. Sherwin-Williams
 - 2. Benjamin Moore
 - 3. PPG
 - 4. Devco
 - 5. Pratt & Lambert
 - 6. Olympic Stain Products
 - 7. U.S. Gypsum Company

PREPARATION

- A. Deliver all materials in unbroken original packages or containers bearing manufacturer's labels.
- B. All material shall be stored and mixed only in such rooms as may be assigned for this purpose and all necessary precautions shall be taken to prevent a fire.
- C. Protect all finished surfaces and all surfaces receiving other materials, which depend on surface bonding, from becoming contaminated by any painting or coating.
- D. Coordinate and schedule painting work so as not to conflict with the work of other trades.
- E. Preparation of surfaces:
 - 1. Wood:
 - a. Sandpaper to smooth and even surface and slightly bevel sharp corners. Clean off all dust, using tack cloth if necessary. After primer has been applied fill nail and other holes and cracks with plastic wood or putty.
 - 2. Steel and Iron:
 - a. Remove grease, rust, scale and dust and touch-up any chipped or abraded places on items that have been shop coated. Where steel and iron have a heavy coating of scale, it shall be removed by wire brushing or sand blasting as necessary to produce a satisfactory surface for painting. Painting over rust and scale will not be allowed.
 - 3. Galvanized Metal:
 - a. Clean thoroughly with mineral spirits or naphtha.
 - 4. General:
 - a. Before painting, hardware, accessories, electrical device plates, lighting fixtures and similar items shall be removed by the installing trade and be replaced after painting work is completed. If items are not removed prior to painting and are damaged they must be repaired or replaced at no additional cost to the Owner.

APPLICATION

- A. Apply materials in a manner to insure smooth, even, uniform coats, free from dirt, runs, brush marks, sags and laps. Apply all paint products in accordance with manufacturer's written instructions.
- B. Doors and trim and steel door frames shall be brushed or sprayed. Interior surfaces of stops, exposed to view, retaining glass shall be painted prior to installation of glass.
- C. All applications, other than on millwork, doors and frames, shall be by brush, spray or roller as recommended by coating manufacturer to produce the best finish. Semi-transparent stain shall be brushed only.
- D. All coats shall be thoroughly dry before the succeeding coat is applied. Allow at least 24 hours between coats.
- E. Sandpaper with number 00 sandpaper between all interior coats on wood or metal surfaces. Steel wool may not be used.
- F. All finishes of each type of paint shall be uniform as to sheen, color and texture.
- G. Prime and back-prime with one coat of primer all surfaces of millwork, trim and woodwork, both interior and exterior. Priming work shall be done when such millwork is first delivered to the job.
- H. Give top and bottom edges of all doors two coats of the same finish applied to faces. Edge finishes on door tops and bottoms shall be applied after all cutting and fitting of door is completed and before weatherstripping is applied.
- I. Miscellaneous ungalvanized steel not exposed in finished areas shall be touched-up to cover bolts, field welds, and all damaged and scuffed areas, immediately after erection, using the same material as used in shop prime coating. One further coat of original priming material shall be given to all surfaces after touch-up primer has dried.

TOUCH-UP & CLEAN-UP

- A. On completion of the building, examine all painted surfaces. Carefully touch-up and repair marred or damaged spots, work over all surfaces that have been repaired by other trades and leave entire work in first class condition.

PAINTING FINISH SCHEDULE

- A. New interior gypsum walls and ceilings:
 - 1. Tape all joints and spread compound over nail or screw heads using perforated tape and joint compound. (Tape and float areas above ceilings which are not finished also).
 - 2. Sand first operation as required, trowel compound out to feather edge over all joints, nail or screw heads and around accessories.
 - 3. Sand second operation as required and apply one coat of combination textured paint containing sealer and primer with a simulated sand finish texture. Submit texture samples to the Architect for approval.
 - 4. Apply 1 coat Sherwin-Williams ProMar 200, Zero VOC, Interior Latex Primer
 - 5. Apply 2 coats Sherwin-Williams ProMar 200, Zero VOC, Interior Latex, low sheen paint.

6. Interior Latex Eg-Shel for Walls, Interior Latex Flat for Ceilings

- B. Interior exterior exposed structural framing and steel joists, metal door and window frames, interior metal guard railings, handrails, interior metal ladders, primed portions of rolling overhead doors and metal lite kits in wood doors: (At frames with glass lites and lite kits in wood doors, paint inside of fixed and applied stops prior to setting glass)
 1. 1st coat – Touch up factory primed surfaces. Pro Industrial Pro-Cryl Universal Acrylic Primer
 2. 2nd & 3rd coats – Sherwin-Williams Pro Industrial DTM Acrylic Eg-Shel Industrial enamel.

- C. Exterior metal frames, bollards, ornamental iron gates, steel lintels and structural framing.
 1. 1st coat – Touch up factory primed surfaces or apply primer (as recommended by paint manufacturer for each substrate).
 2. 2nd & 3rd coats – Sherwin-Williams Pro Industrial DTM Acrylic Eg-Shel Industrial enamel

- D. Painted interior, plywood and trim, plywood telephone/computer equipment boards:
 1. 1st coat – Sherwin-Williams ProBlock Interior Oil-Based Primer
 2. 2nd & 3rd coats – Sherwin-Williams 200 Interior Alkyd semi-gloss enamel.

- E. Stained wood sills, cabinets and shelving, and interior woodwork, trim, plywood seating and railings
 1. Apply paste filler and satin sheen oil stain. Color as selected by Architect.
 2. Apply 3 coats clear satin sheen – Sherwin-Williams Wood Classics Polyurethane Varnish

- F. Interior and exterior mechanical, plumbing and electrical equipment, including machinery, roof top A/C units, electrical switches and panels, meters, piping and conduits, uninsulated water and sewer lines and similar items (excluding copper) exposed to view: Mask all equipment nameplates and information plates or tags.
 1. 1st coat on primed or factory painted equipment - Touch-up scars and scratches with primer.
 2. 1st coat on black steel - Maintenance primer.
 3. 2nd & 3rd coats - Satin sheen industrial enamel.

- G. Blackout duct interiors in sight line, but not less than 15” back from registers, grilles and diffusers:
 1. One coat flat, wrought iron, black.

- H. Parking space striping and hatching:
 1. One coat white commercial parking lot striping paint suitable for concrete paving or asphalt paving (verify paving type).

COLORS

- A. Interior/Exterior Finish Colors are scheduled on drawings. Colors of paints (including stains) shall match control samples.

- B. Traffic Paint
 1. Parking Stall Strips: White
 2. Crosswalks: State of Texas Reflective Yellow
 3. Painted Medians: State of Texas Reflective Yellow
 4. Handicap Curb Ramps: State of Texas Reflective Yellow
 5. Fire Lanes: Red.

COMPLETION

- A. Furnish Owner a typewritten list of paint schedule in duplicate, listing manufacturer's names, types of paint and color numbers or custom mix formulas.

END OF SECTION 09 90 00

SECTION 09 97 23 – CONCRETE FLOOR SEALER

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

PART 1 - GENERAL

SECTION INCLUDES

- A. Application of membrane type curing and sealing compound on concrete surfaces to remain exposed.

PART 2 - PRODUCT

MANUFACTURER

- A. Manufacturers listed below whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications, comply with Division 1 requirements regarding substitutions to be considered and have Architect's approval prior to its use on the Project.
 1. Basis-of-Design: L&M Construction Chemicals, which is located at: 1 LATICRETE Park N.; Bethany, CT 06524-3423; Toll Free Tel: 800-362-3331; Tel: 402-453-6600; Email: request info (info@lmcc.com); Web: www.laticrete.com/lmcc
 2. Dayton-Superior Corp
 3. Euclid Chemical Company
 4. W.R. Meadows, Inc.

2.2 MATERIALS

- A. Lithium-Silicate Concrete Hardener, Sealer, Densifier:
 1. Basis-of-Design: L&M Construction Chemicals, Inc., Lion Hard

PART 3 - EXECUTION

3.1 APPLICATION

- A. Concrete slabs shall be smooth, dry, and free of any foreign materials.
- B. Apply two (2) coats of specified finish in accordance with manufacturer's instructions.
- C. Allow approximately 24 hours drying time between installation of coats. Do not apply second coat until Architect has inspected first coat application.
- D. Install coating after all painting operations are completed.

END OF SECTION 09 97 23

SECTION 10 01 00 – MISCELLANEOUS SPECIALTIES

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

SECTION INCLUDES

- A. Furnish and install the following:
 - 1. Rapid Entry System (Fireman's Knox Box)
 - 2. Defibrillator Cabinet

RELATED SECTIONS

- A. Section 03 30 00 - Cast-in-Place Concrete
- B. Section 04 20 00 - Unit Masonry
- C. Section 05 50 00 - Miscellaneous Metals: Metal bracing, fasteners and other support components
- D. Section 06 10 00 - Rough Carpentry: Wood blocking
- E. Section 09 21 16 - Gypsum Board Assemblies
- F. Section 09 51 13 - Acoustical Ceilings
- G. Division 26 - Electrical

SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
 - 3. Manufacturer's operation and maintenance data, as applicable.
- B. Shop Drawings: Show sizes, locations and installation details. Include utility (electrical, water, gas) requirements.
- C. Samples: Color charts showing manufacturer's full range of colors.

COORDINATION

- A. Coordinate Work of this Section with work of other sections in which items are to be installed.

APPROVED MANUFACTURERS

- A. Specifications are based on named products and manufacturers. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.

MATERIALS

- A. Rapid Entry System (Fireman's Lock Box)
 - 1. Model 3200 Series Knox Box with weather resistant gasketed hinged door. Recessed installation kit for installation when in masonry and plaster.
 - 2. Exterior Dimension: 7"h x 7"w x 3 1/4"d.
 - 3. Lock: UL listed. Best lock with double-action rotating tumblers and hardened steel pins.
 - 4. Finish: Pre-treatment, Zinc-phosphate to Federal Standard TTC 490 Type II.

- Final Coating: Weather resistant interior and exterior TGIC polyester powder coating
5. Finish Color: Black Aluminum Finish.

B. Defibrillator Cabinet:

1. Model 1427, tub size 14" x 14" x 6 3/4" deep frame outside dimensions 17 1/2" x 17 1/2", door style F12, clean anodized finish, with standard "SA" Siren Strobe Alarm (85 dB alarm when door opens and turns off when door closes, 9 volt battery shall be included).
2. Two defibrillator cabinets to be located by Owner, installed by Contractor.

EXAMINATION

- A. Verify utility (electrical, water, and gas) requirements, where applicable, are installed and ready for connection.
- B. Verify items fastened to walls have proper blocking or support items installed.
- C. Verify locations for items are ready for their installation.

INSTALLATION

- A. Install all items in accordance with manufacturer's printed instructions in locations shown on drawings.

CLEANING AND ADJUSTING

- A. Make final adjustment after installation and clean all backstop support piping of dirt and other substances which may affect final finish.
- B. Clean all items of dirt and foreign matter which may affect appearance and operation.
- C. Adjust items for proper operation.
- D. Instruct Owner's personnel on proper operation and maintenance of items.

END OF SECTION 10 01 00

SECTION 10 14 00 – GRAPHICS

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

SECTION INCLUDES

- A. Include in Base Proposal the amount for furnishing and installing the following signage in locations as indicated on the Drawings:
 - 1. Restroom signage
 - 2. Exit signage.
 - 3. Dedication Plaque
 - 4. Brackets, clips, posts, fasteners, and all accessories required for proper installation of signage and dedication plaque.

SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
- B. Shop Drawings:
 - 1. Indicating materials, sizes, and finishes, details of fabrication and installation, fasteners and hardware, attachments, related and adjacent work.
- C. Samples:
 - 1. One (1) actual sample of each type room identification sign with specified finish.
 - 2. One (1) 6 inch x 6 inch sample of cast metal plaque material with specified finish.

QUALITY ASSURANCE

- A. Americans with Disabilities Act (ADA)
- B. Texas Accessibility Standards (TAS)

ACCEPTABLE MANUFACTURERS

- A. Specifications are based on products and manufacturers listed as basis of specification or design. Products of manufacturers listed which meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered. All deviations from basis-of-design listed in drawings shall be required to submit substitution request during bidding to be evaluated by architect.

MATERIALS

- A. Cast Metal Dedication Plaque:
 - 1. Material and Fabrication:

- a. Casting: Shall be of virgin ingots of F-214 Aluminum Alloy and shall be free of pits and gas holes and all letters shall be sharp and hand tooled.
 - b. Border Style: Single line standard border design.
 - c. Letter Style/Sizes: Shall be Helvetica Medium in both upper and lower case letters, unless shown otherwise. Letter sizes shall be as shown on drawings.
 - d. Finishes:
 - 1) Borders and Letter Faces: Shall be satin finish.
 - 2) Background: Shall be leatherette texture sprayed with Gun Metal Gray acrylic lacquer.
 - 3) Plaque shall be chemically cleaned and etched and treated with alodine.
 - 4) Completed plaque shall be sprayed with two (2) coats of clear acrylic lacquer.
 - e. Size: Shall be as shown on drawings.
2. Fasteners and Attachment Hardware: Concealed fasteners and hardware of size and type recommended by manufacturer for attachment of plaque on masonry wall where indicated on drawings.
 3. Provide all materials required for a complete installation.
 4. Approved Manufacturers:
 - a. A.R.K. Ramos Architectural Signage Systems, Oklahoma City, OK; (405) 235-5505
 - b. Best Manufacturing Sign Systems, Montrose, CO; (800) 235-2378
 - c. York Bronze Company, Bryan, TX; (800) 488-4662
 - d. Corpus Christi Stamp Works, Inc., Corpus Christi, TX; (361) 884-4801
 - e. Matthews Bronze, Pittsburgh, PA; (800) 950-1317
 - f. Metal Arts, Division of L & H Mfg. Co., Mandan, ND; (800) 237-8069
 - g. ProWorx Architectural Signage, Houston, Texas; (713) 666-3131
 - h. The Southwell Co., San Antonio, TX; (210) 223-1831

B. Restroom & Exit Signage

1. General:
 - a. Constructed of one (1) or two (2) high pressure laminate in colors indicated on drawings, laminated to a 1/8 inch thick acrylic back.
 - b. Signage shall have radius or square corners with square-cut edges painted a color as selected by Architect.
 - c. Demarcation line, if any, shall be infilled to match copy color.
 - d. Signs shall comply with all state and federal codes, including, but not limited to the ADA and TAS requirements.
 - e. Refer to drawings for signage details for dimensions, types, colors, graphic layout, and mounting and height specifications.
2. Room Numbers, Symbols, and Restroom Copy:
 - a. Shall be matte finished acrylic, raised 1/32 inch, of a color contrasting to the face laminate.
 - b. Characters and pictograms shall be chemically welded to the acrylic backing, through the face laminate, to assure permanent adhesion.
 - c. Room numbers and restroom copy shall be accompanied by Grade II braille by means of "VisiTouch Duradot System". Glass or metallic "Durodots" shall have 0.059 inch surface diameter with body of sphere pressure secured below face laminate. Routed boxes or glued on dots are not acceptable.
3. Restroom Pictograms:
 - a. Shall appear on a minimum six (6) inch square, unobstructed field.
4. Fasteners and Accessories:
 - a. 1/8 inch thick, double-sided foam tape of type recommended to suit application and commercial grade silicone sealant.
 - b. Back-up plates shall be supplied, where shown or required, for signage mounted on glass.
5. Provide all materials required for a complete installation.

6. Approved Manufacturers:
 - a. Signage:
 - 1) South Texas Graphic Specialties, Inc., Houston, TX; (713) 467-4499 (Basis of Specification)
 - 2) Stanley Signature Signs, Katy, Texas; (281) 395-6106
 - 3) ProWorx Architectural Signage, Houston, Texas; (713) 666-3131
 - 4) Motivational Systems, Inc. San Antonio, TX; (210) 805-9555
 - b. Plastic Laminate:
 - 1) Nevamar
 - 2) Wilsonart (Basis-of-Design)
 - 3) Pionite
 - 4) Formica
 - 5) Panolam

INSTALLATION

- A. Restroom Signs:
 1. Install in accordance with manufacturer's instructions.
 2. Install (1) sign at corridor side of all restrooms.
 3. Install with double-sided foam tape and a bed of silicone sealant.
- B. Exit Signs:
 1. Install in accordance with manufacturer's instructions.
 2. Install (1) sign at all exterior door locations.
 3. Install with double-sided foam tape and a bed of silicone sealant.
 4. Where shown or required, mount signs on glass using back-up plates.
- C. Cast Metal Dedication Plaque:
 1. Install in accordance with manufacturer's instructions.
 2. Install in location as directed by Owner and Architect.
 3. Install with concealed fasteners of threaded bolt screwed into back of plaque and inserted into hole drilled in masonry wall.

END OF SECTION 10 14 00

SECTION 10 21 13 – HIGH DENSITY POLYETHYLENE TOILET PARTITIONS

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

SECTION INCLUDES

- A. High Density Polyethylene (solid plastic) toilet partitions, floor mounted, overhead braced.

SUBMITTALS

- A. Shop Drawings: Within four (4) weeks of award of contract, submit:
 - 1. Complete shop drawings for the Architect's approval, showing all required field measurements, all details and elevations, plans and sections required to indicate all conditions.
 - 2. Manufacturer's installation instructions.
- B. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns. Submit manufacturer's standard color selector.
- C. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum 5 years manufacturing toilet partitions.
- B. Installer Qualifications: Minimum 2 years experience installing toilet partitions.
- C. Certification: Provide a certificate of compliance attesting that all materials are in accordance with manufacturer's specifications.

DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

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. Manufacturer's storage and handling instruction shall be reviewed and maintained.
- B. Field Measurements: Take field measurements prior to component fabrication to ensure proper fitting of work.

- C. Coordination: Furnish inserts and anchorages that will be built into other work for installation of toilet compartments and related items

PRODUCTS

APPROVED MANUFACTURERS

- A. Basis-of-Design Product: ASI Accurate Partitions, An ASI Group company; 900 Clary Connector, Eastanollee, Georgia 30538, Phone: 706.827.2700, Fax: 706.827.2710, asi-globalpartitions.com

or comparable product by one of the following:

1. Accurate Partitions Corporation, Lyons, IL; (708) 442-6801
2. Bobrick Washroom Equipment, Inc., North Hollywood, CA; (281) 362-7575
3. Bradley Corporation, Menomonee Falls, WI; (800) 272-3539
4. DesignRite Partitions (Spec-Rite Designs), St. Louis, MO; (877) 249-6864
5. Flush-Metal Partition, Maspeth, NY; (718) 784-3380
6. Global Steel Products Corp., Deer Park, NY; (631) 586-3330
7. Knickerbocker Partition Corp., Irving, TX; (972) 438-5330
8. Metpar Corp., Westbury, NY; (516) 333-2600
9. Partition Systems, Inc. (Columbia Partitions), Columbia, SC; (803) 765-9980
10. Tex-Lam Manufacturing, Inc., Houston, TX; (713) 695-5975

MATERIALS

- A. General: Comply with the Americans with Disabilities Act (ADA) and Texas Accessibility Standards (TAS).
- B. Doors and Panels: 1 inch thick solid high density polyethylene formed under pressure. Solid color throughout. All edges to be machined radius and all sharp edges removed.
- C. Pilasters: 40 Series shall be same construction as doors and panels. Pilasters are to be anchored to the floor with heavy gauge angle. Top of pilasters to be securely braced with extruded aluminum headrail with integral crown loafer rail .
- E. Headrail: 1 7/8in x 1 1/32in x 1/16in with integral crown loafer rail, extruded aluminum heat treated and anodized with necessary fittings.
- F. Hardware: Hinges shall be fabricated from 11 gauge stainless steel, one piece leaf, for surface mounting. Hinge shall be equipped with one piece 3/8 inch stainless steel pintle extending the full height of the hinge. Upper and lower hinge are to both be cam operated, with the one piece pintle.
1. Coat hook and bumper to be 14 gauge stainless steel.
 2. Door strike and keeper shall be 14 gauge stainless steel.
 3. Bracket for wall and partition attachment shall be continuous 14 gauge stainless steel.
 4. Pilaster shall be attached to the floor by means of an 11 gauge stainless steel footer, with provisions for leveling, attached to two (2) 3/8 inch diameter stainless steel studs set into expansion shields. The floor connections are to be covered by a four (4) inch high stainless steel shoe.
- H. Color: Refer to drawings for finish and material selections basis-of-design. The architect will attempt to select colors from the manufacturer preferred by the subcontractor; however, if the

standard colors do not prove to be an entirely satisfactory match to the color selected in the drawings the subcontractor shall provide the exact color and finish as indicated in the drawings.

EXECUTION

INSTALLATION

- A. Install in accordance with manufacturer's printed instructions.
- B. Install all toilet partitions where indicated on the drawings, and as indicated on the shop drawings, anchoring all components firmly in place for long life under hard use and in complete accordance with the manufacturer's recommendations.
- C. Provide blocking/anchoring devices to secure to wall. Anchoring devices must be compatible to wall type to ensure adequate strength.

CLEANING AND ADJUSTING

- A. Clean surfaces free of dirt, oil, grease and other contaminants which detract from appearance of partitions.
- B. Except for compartments for the handicapped, adjust doors to remain at a uniformly open position when unlocked.

REPLACEMENT OF DEFECTIVE MATERIALS

- A. Defaced, damaged, scratched or marred materials will not be permitted, will be considered defective, and rejected. Rejected materials shall be replaced with new materials at no additional expense to the Owner.

END OF SECTION 10 21 13

SECTION 10 28 13 – TOILET ROOM ACCESSORIES

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

SECTION INCLUDES

- A. Toilet room and miscellaneous accessories installed throughout the facility specified herein.

RELATED SECTIONS

- A. Section 04 20 00 - Unit Masonry
- B. Section 05 40 00 - Cold-Formed Metal Framing
- C. Section 09 21 16 - Gypsum Board Assemblies
- D. Section 09 30 00 - Tiling
- E. Section 10 21 13 – High Density Polymer Toilet Partitions
- F. Section 26 00 00 - Electrical

SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
 - 1. Construction details and dimensions.
 - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Material and finish descriptions.
 - 4. Features that will be included for Project.
 - 5. Manufacturer's warranty.
- B. Product Schedule: Tabular or spreadsheet format indicating types, quantities, sizes and installation locations by room of each accessory required.
- C. Provide statement from Installer that all mounting heights, clearances, and reach ranges for accessories have been reviewed and confirmed to be in compliance with Texas Accessibility Standards as required.

QUALITY ASSURANCE

- A. Comply with ANSI A117.1 and Texas Accessibility Standards (TAS) for age-appropriate mounting heights, reach ranges and clearances required.
- B. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

WARRANTY

- A. Warrant the work specified herein for three (3) years, or provide manufacturer's standard warranty for specified products, against becoming unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials and workmanship.
- B. Defects shall include, but not be limited to:
 - 1. Delamination or deterioration of finish.
 - 2. Noisy, rough or difficult operation.
 - 3. Failure to meet specified quality assurance requirements.

MANUFACTURERS

- A. Toilet Accessories - General:
 - 1. Bobrick Washroom Equipment, Inc. (BWE)
 - 2. Bradley Corporation (BRAD)
 - 3. American Specialties, Inc.(ASI)
 - 4. Substitutions: Under provisions of Section 01 25 00.
- B. Specifications are based on products of Bobrick Washroom Equipment, Inc., (281) 362-7515, unless specific manufacturer is noted otherwise.
- C. Owner Furnished/Supplier Installed Liquid Soap Dispensers, Paper Towel Dispensers, and Toilet Paper Dispensers. Contractor to coordinate supply of dispensers with owner and install per TAS.

MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 22 gauge minimum nominal thickness unless otherwise indicated.
- B. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.
- C. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.
- D. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- F. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- G. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, 1/4 inch thick.
- H. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

FINISHING

- A. Stainless Steel: No. 4 satin brushed, typical on all accessories unless otherwise noted.
- B. Baked Enamel: Pretreat to clean condition, apply one coat primer and minimum two coats vitreous enamel.
- C. Chrome/Nickel Plating: Satin finish.
- D. Shop Primed Ferrous Metals: Pretreat and clean, spray apply one coat primer and bake.
- E. Back paint components where contact is made with building finishes to prevent electrolysis.

ACCESSORIES SCHEDULE

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Refer to drawings for full accessories schedule.

INSTALLATION

- A. Comply with ADA and TAS requirements. Refer to Drawings. When not shown, submit supplier's recommendations for locations and mounting height before proceeding. Contractor shall be responsible for any relocation, including repair work, made necessary by relocation due to failure to comply with ADA and TAS requirements.
- B. Contractor shall be responsible for supplying all opening, blocking, and other components necessary for installation of all toilet accessories.
- C. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored.
- D. Use approved theft-resistant type fasteners.

ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 10 28 13

SECTION 10 44 00 – FIRE PROTECTION SPECIALTIES

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

WORK INCLUDED

- A. Fire Extinguishers
- B. Cabinets

REFERENCES

- A. NFPA 10 – Portable Fire Extinguishers
- B. ADA Accessibility Guidelines

QUALITY ASSURANCE

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Provide fire extinguisher, cabinets and accessories by single manufacturer.

SUBMITTALS

- A. Product Data:
 - 1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
 - 2. Manufacturer's installation instructions.
- B. Product Schedule: For fire extinguishers. Coordinate final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function.

PRODUCTS

ACCEPTABLE MANUFACTURERS

- A. Specifications are based on the products of named manufacturers. Other listed manufacturers who produce products equivalent to those specified are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent to those specified and comply with Division 1 requirements regarding substitutions to be considered.

Portable Fire Extinguishers:

Badger; Div of Figgie Fire Protection Systems. 1-800-446-3857 www.badgerfire.com
General Fire Extinguisher Corporation. 800-323-6452 www.genfire.com
J.L. Industries, Inc 1-00-554-6077 www.jlindustries.com
Kidde: Walter Kidde, The Fire Extinguisher Co. www.kidde.com
Larsen's Manufacturing Company. 800-527-7367 www.larsenmfg.com

MATERIALS

- A. Cold-Rolled Steel Sheet: Carbon steel, complying with ASTM A 366/A 366M, commercial quality, stretcher leveled, temper rolled.

PORTABLE FIRE EXTINGUISHERS

- A. General: Provide fire extinguishers of type, size and capacity for each cabinet and other locations indicated.
- B. Multipurpose Dry-Chemical Type: UL-rated 4-A:60B:C, 10-lb (4.5-kg) nominal capacity, in enameled steel container.

FIRE PROTECTION CABINETS

- A. Cabinet Construction: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld joints and grind smooth. Miter and weld perimeter door frames.
- B. Fire Rated Cabinets: Listed and labeled to meet requirements of ASTM E 814 for fire-resistance rating of wall where it is installed.
Construct fire-rated cabinets with double walls fabricated from 0.0478-inch thick, cold rolled steel sheet lined with minimum 5/8-inch thick, fire-barrier material. Provide factory drilled mounting holes.
Cabinet Metal: Enameled-steel sheet, color - white.
- C. Cabinet type: Suitable for the following:
- D. Cabinet Mounting:
Fully recessed: Cabinet box fully recessed in walls of depth to suit style of trim indicated.
- E. Cabinet Trim Style: 5/16" flat trim, fully recessed, color - white
- F. Cabinet Trim Material: Manufacturer's standard as follows:
Same metal and finish as cabinet.
- G. Door Material: Manufacturer's standard as follows:
Enameled-steel sheet, color - white
- H. Door Glazing: Manufacturer's standard as follows:
Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, as follows:
Class 1 (clear)
- I. Door Style: Manufacturer's standard as follows:
Fully glazed panel with frame.
- J. Door Construction: Fabricated doors according to manufacturer's standards, of materials indicated, and coordinated with cabinet types and trim styles selected.
- K. Door Hardware: Provide manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide either lever handle with cam-action latch, or exposed or concealed door pull and friction latch. Provide concealed or continuous-type hinge permitting door to open 180 degrees.

ACCESSORIES

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure extinguisher, of sizes required for types and capacities of extinguishers indicated, with plated or baked-enamel finish.
Provide brackets for extinguishers not located in cabinets
Provide brackets for extinguishers located in cabinets.
- B. Identification: Provide lettering to comply with authorities having jurisdiction for letter style, color, size, spacing, and location.

Identify bracket-mounted extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to wall surface.

Identify fire extinguisher in cabinet with the words "FIRE EXTINGUISHER" applied to door.

Application process: Vinyl Letters.

Lettering Color: White

Orientation: Vertical

EXECUTION

INSTALLATION

- A. General: Install fire protection cabinets in locations or required by authorities having jurisdiction and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
- B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.
- C. Examine fire extinguishers for proper charging and tagging.
Remove and replace damaged, defective, or undercharged fire extinguishers.
Install fire extinguishers in compliance with requirements of authorities having jurisdiction.

ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.
- E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures

END OF SECTION 10 44 00

SECTION 10 73 10 – PROTECTIVE COVERS

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

SCOPE

- A. Design and installation of extruded aluminum canopies.

REFERENCES

- A. The Aluminum Association - Aluminum Design Manual 2010.
- B. American Welding Society - AWS D1.2/D1.2M: 2008

SUBMITTALS

- A. Product Data: Submit complete set of manufacturer's product information, specifications, component performance data and installation instructions for walk way components and accessories.
- B. Shop Drawings: Submit complete set of detailed drawings, layout of cover system, bent locations, all mechanical joint locations with complete details, connections, jointing and accessories. Include details bent anchorage. Include plan dimensions, elevations and details.
- C. Samples: Provide color chart including manufacturer's full range of colors for the finishes selected. Upon initial color selection by Architect, provide 3 inch square actual color samples of each finish selected on the substrate specified.
- D. Design Data: Provide structural design calculations for the proposed cover, signed and sealed by a professional engineer, licensed in the state of Texas, who professes his discipline to be structural engineering. Design calculations shall state that the cover system design complies with the wind requirements of ASCE 7, the stability criteria of applicable building code, and all other governing criteria.

QUALITY ASSURANCE

- A. Manufacturer Qualifications: At least ten years experience in the design, fabrication, and erection of extruded aluminum walkway cover systems.
- B. Installer Qualifications: Have walkway covers installed by manufacturer, third party installation is not acceptable. Installer Qualification: Firm with not less than three (3) years experience in installation of aluminum walkway covers of type, quantity and installation methods similar to work of this section.
 - 1. Codes and Standards: Comply with provisions of the following except as other-wise indicated: International Building Code, latest addition with amendments, if any. AWS (American Welding Society) standards for structural aluminum welding.
 - 2. Manufacturer: Obtain aluminum covered walkwaysystem from only one (1) manufacturer, although several may be indicated as offering products complying with requirements.
 - 3. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication where possible, to insure proper fitting of work. However, allow for adjustments

within specified tolerations wherever taking of field measurements before fabrication might delay work.

4. Shop Assembly: Preassemble units in shop to greatest extent possible and disassemble as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
5. Coordination: Coordinate work of this section with work of other sections, which interface with installation of the canopy system (sidewalks, curbs, building fascias, etc.).
6. Damaged Units: Replace roof deck panels and other components of the work, which have been damaged or have deteriorated beyond successful minor repair.

PRODUCTS

MANUFACTURERS

- A. The design is based on products fabricated by: Avadek Walkway Cover Systems & Canopies, Houston, TX (713) 944-0988.
 1. Comparable products by the following manufacturers also will be acceptable:
 - a. Dittmer Architectural Aluminum, 800-822-1755, www.ditt-deck.com.
 - b. E.L. Burns Company, 800-576-2722, www.burnscovers.com
 - c. Peachtree Protective Covers, 800-341-3325, www.peachtreecovers.com.
 - d. Architectural Metal Systems, 888-621-5020, www.ametalsystems.com
 - e. Mapes Industries, Inc. 800-228-2391, www.mapes.com
 2. Substitutions: Comparable products of other manufacturers will be considered under standard substitution procedures. Refer to section 01 25 00 Substitution Procedures.
- B. Other extruded aluminum walkway cover manufacturers wishing to submit equivalent system proposals on this project must request prior approval from the Architect for their products.
- C. Submit requests for approval at least seven (7) days prior to proposal date, so that proper notification of approval, if granted, can be given to all proposers by addendum.
- D. Those requesting prior approval must submit sufficient technical information regarding their products so that the Architect can adequately compare equity to products currently specified. Any and all variations from Architect's drawings and specifications must be clearly and completely described in request for substitution.
 1. Submit evidence of having operated a successful business of manufacturing and installing complete extruded aluminum canopy systems.
 - a. Business must have been in operation under submitted name and ownership for a minimum of ten (10) years.
 - b. Submit a list of successfully completed projects of similar scope, size and complexity within the state of Texas. List shall include job name, date of completion, architect's firm name, address and phone number, owner's name with representative and phone number.
 - c. Submit complete shop drawings for above completed jobs.
 - d. Submit complete details with structural properties (moment of inertia, section modules, modules of elasticity, etc.) for all proposed sections (beams, columns, decking and other structural members).

MATERIALS

- A. All components shall be 6063, 6061 or 6005 alloy extruded aluminum.
- B. Components shall be sized to comply with live load and wind load requirements of the project and shall not be less than the dimensions shown on the plan.
- C. The thickness of aluminum deck panels shall be at least .080" thick.
- D. Flashing shall be .040" thick.
- E. All bolts and fasteners shall be stainless steel of finished to match adjacent components and sized by canopy engineer.

FINISHES

- A. The finish and color of each component shall be Roman Bronze.

EXECUTION

FABRICATION

A. General.

1. General contractor shall field verify all bent locations, dimensions and elevations shown on shop drawings prior to fabrications.
2. Shop Assembly: Assemble components in shop to greatest extent possible to minimize field assembly.
3. Comply with indicated profiles, dimensional requirements and structural requirements. Use sections true to details with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture, free from defects impairing strength and durability.
4. Welding: In accordance with ANSI/AWS D1.2.
5. Bent Construction: Factory weld beams with neatly mitered corners to form one-piece rigid bents. Make welds smooth and uniform using an inert gas shielded arc. Perform suitable edge preparation to assure 100% penetration. Grind welds only where interfering with adjoining structure to allow for flush connection. Field welding is not permitted. Rigid mechanical joints may be used only if fully welded bents cannot be shipped on local, state, or federal highways without a special permit from the department of transportation (mechanical joints, if required, shall consist of stainless steel bolts with a minimum of two (2) bolts per fastening. Bolts and nuts shall be installed in a concealed manner using utilizing 1/2" thick by 1 1/2" aluminum bolt bars welded to structural members. All such mechanical joint must be detailed on shop drawings showing all locations).
6. Deck Construction: Fabricate from extruded modules that interlock in a self-flashing manner. Positively fasten interlocking joints at 8 inches on center creating a monolithic structural unit capable of developing the full strength of the sections. The fastenings must have minimum shear strength of 350 pounds each. Assemble deck with sufficient camber to offset dead load deflection.

- B. Beams: Provide open-top tubular extrusion, top edges thickened for strength and designed to receive deck members in self-flashing manner. Provide structural ties in tops of all beams.

- C. Deck: Extruded self-flashing sections interlocking into a composite unit. Provide welded plate closures at deck ends. Shop fabricate to lengths and panels widths required for field assembly. Depth of sections shall comply with structural requirements. Provide shop induced camber in deck units with spans greater than 16'- 0" to offset dead load deflections. Welded dams are to be used at non-draining ends of deck.
- D. Fascia: Manufacturer's standard shape. Provide fascia splices where continuous runs of fascia are jointed. Locate splices to be in line with bents and fasten in place on hidden or non-vertical surfaces.

EXAMINATION

- A. Verification of Conditions: Verify that all concrete, masonry, and roofing work in the vicinity is complete and cleaned. Examine all adjacent work / surfaces for conditions that would prevent quality installation of this system. Do not proceed until defects are corrected.

DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle covered walkway system components as recommended by manufacturer. Handle and store in a manner to avoid deforming members and to avoid excessive stresses.

ERECTION

- A. Erect protective cover true to line, level, and plumb.
- B. Provide hairline miters and fitted joints.
- C. Install roof deck sections, accessories and related flashing in accordance with manufacturer's instructions. Provide roof slope for rain drainage without ponding water. Align and anchor roof deck units to structural support frames.
- D. Assemble all components in a neat, workmanlike manner.

CLEANING

- A. Remove protective coverings at time in project construction sequence which will afford greatest protection of work. Clean all finished surfaces as recommended by manufacturer. Maintain in a clean condition during construction.

PROTECTION

- A. Advise general contractor of protection and surveillance procedures, as required to ensure that work of this section will be without damage or deterioration at time of substantial completion. Protect all materials during and after installation.

WARRANTY

- A. Manufacturer shall warrant the entire system against defects in labor and materials for a period of one (1) year commencing on the date of substantial completion as established in Division One of these specifications.

- B. Intention of this warranty is the manufacturer will come onto the jobsite and do all necessary to effect corrections of any deficiencies.
- C. Prima Facie Evidence of defects in labor and material may include but is not limited to, one or more of the following:
1. Moisture leaks.
 2. Metal failure including excessive deflection.
 3. Fastener failure.
 4. Finish failure.

END OF SECTION 10 73 10

SECTION 12 24 00 – WINDOW SHADES

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

WORK INCLUDED

- A. The Contractor shall provide and install window shades at windows A12 & A13 in Vestry and St. Anne's Room and indicated on drawings.
- B. All requests for substitution must be submitted in accordance with procedures outlined the Instructions to Bidders.

SECTION INCLUDES

- A. Window shades and accessories.

RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.
- B. Section 09 51 00 - Acoustical Ceilings: Shade Pockets, pocket closures and accessories.

REFERENCE STANDARDS

- A. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2015.
- B. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week prior to commencing work related to products of this section; require attendance of all affected installers.
- B. Sequencing:
 - 1. Do not fabricate shades until field dimensions for each opening have been taken.
 - 2. Do not install shades until final surface finishes and painting are complete.

SUBMITTALS

- A. See Section 01 33 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
- C. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb and sill details, mounting dimension requirements for each product and condition, and operation direction.

- D. Certificates: Manufacturer's documentation that line voltage components are UL listed or UL recognized.
- E. Source Quality Control Submittals: Provide test reports indicating compliance with specified fabric properties.
- F. Selection Samples: Include fabric samples in full range of available colors and patterns.
- G. Verification Samples: Minimum size 6 inches square, representing actual materials, color and pattern.
- H. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- I. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.
- K. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

QUALITY ASSURANCE

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

MOCK-UP

- A. Mock-Up: Provide full size mock-up of window shade complete with selected shade fabric including sample of seam when applicable.
 - 1. Obtain Architect's approval of light and privacy characteristics of fabric prior to fabrication.
 - 2. Full-sized mock-up may become part of the final installation.

DELIVERY, STORAGE, AND HANDLING

- A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.
- B. Handle and store shades in accordance with manufacturer's recommendations.

FIELD CONDITIONS

- A. Do not install products under environmental conditions outside manufacturer's absolute limits.

WARRANTY

- A. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
 - 1. Roller Shade Hardware, Chain and Shadecloth: Manufacturer's standard non-depreciating twenty-five year limited warranty.

2. Roller Shade Installation: One year from date of Substantial Completion, not including scaffolding, lifts or other means to reach inaccessible areas.

MANUFACTURERS

- A. Roller Shades:
 1. MechoShade System, Inc.: www.mechoshade.com
 2. Draper, Inc: www.draperinc.com/sle.
 3. Hunter Douglas: www.hunterdouglas.com.
 4. Lutron Electronics Co., Inc: www.lutron.com.
 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. (Basis of Design): Manual Shade System
 1. MechoShade System, Inc.: Mecho/5
- C. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

WINDOW SHADE APPLICATIONS

- A. Shades: Translucent shades.
 1. Type: Roller shades.
 - a. Fabric: Blackout: Classic Blackout 0700 Series
 2. Color: Graphite 0717.
 3. Mounting: Inside (between jambs).
 4. Operation: Manual.

ROLLER SHADES

- A. Roller Shades: Fabric roller shades complete with mounting brackets, roller tubes, hembars, hardware and accessories; fully factory-assembled.
 1. Drop: Regular roll.
 2. Size: As indicated on drawings.
- B. Fabric: Non-flammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
 1. Blackout Shades: Block virtually all the light; Openness Factor equal to zero (0).
 2. Flammability: Pass NFPA 701 large and small tests.
- C. Roller Tube: As required for type of operation, extruded aluminum with end caps.
 1. Dimensions: Manufacturer's standard, selected for suitability for installation conditions, span, and weight of shades.
 2. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge.
- D. Hembars and Hembar Pockets: Wall thickness designed for weight requirements and adaptation to uneven surfaces, to maintain bottom of shade straight and flat.
 1. Style: Full wrap fabric covered bottom bar, flat profile with closed ends.

ACCESSORIES

- A. Fascias: Size as required to conceal shade mounting.
 - 1. Style: As selected by Architect from shade manufacturer's full selection.
 - 2. Material and Color: To match shade.
- B. Brackets and Mounting Hardware: As recommended by manufacturer for mounting configuration and span indicated.
- C. Fasteners: Non-corrosive, and as recommended by shade manufacturer.

FABRICATION

- A. Field measure finished openings prior to ordering or fabrication.
- B. Fabricate shades to fit openings within specified tolerances.
 - 1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch space between bottom bar and window sill.
 - 2. Horizontal Dimensions - Inside Mounting: Fill openings from jamb to jamb.
- C. Dimensional Tolerances: As recommended in writing by manufacturer.

EXAMINATION

- A. Examine finished openings for deficiencies that may preclude satisfactory installation.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Start of installation shall be considered acceptance of substrates.

PREPARATION

- A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.
- B. Coordinate with window installation and placement of concealed blocking to support shades.

INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.
- B. Installation Tolerances:
 - 1. Inside Mounting: Maximum space between shade and jamb when closed of 1/16 inch.
 - 2. Maximum Offset From Level: 1/16 inch.
- C. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.
- D. Adjust level, projection and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

CLEANING

- A. Clean soiled shades and exposed components as recommended by manufacturer.
- B. Replace shades that cannot be cleaned to "like new" condition.

PROTECTION

- A. Protect installed products from subsequent construction operations.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 12 24 00

SECTION 12 34 10 – CASEWORK

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

PART 1 GENERAL

SCOPE

- A. Provide and install all base cabinets, upper cabinets, tall cabinets, special use cabinets, countertops, backsplashes, fillers and grounds specified herein and shown on the drawings.
- B. Provide and install sinks located in casework units. Provide removable backs in all casework necessary to gain access to plumbing connections and/or chases.
- C. Provide and install grommets in countertops for electrical cords; coordinate location with drawings. Show all locations on countertop plans during submittal process.

SUBMITTALS

- A. Submit shop drawings in accordance with the requirements of Article 3.12 of the General and Supplementary Conditions, complete with either catalog cut sheets or physical samples of all required hardware. Drawings shall indicate cabinet style, size, clear depth dimensions, filler requirements, and section information necessary for proper installation of all equipment. Provide an equipment list for all accessories furnished by the casework manufacturer as required by these documents. Provide profile of all countertops with dimensions and finished end locations.
 - 1. Plastic Laminate Color Charts:
The architect will attempt to select colors from the plastic laminate selections preferred by the subcontractor; however, if the the full range of colors and patterns do not prove to be an entirely satisfactory match to the laminates selected in the drawings the subcontractor shall provide the laminates exactly as specified in the drawings.

QUALITY ASSURANCE

- A. The casework manufacturer shall ensure the final casework structure is safe and stable when carrying the maximum intended loads, as measured against the load ratings of the fully extended, specified sliding drawer and shelf hardware.
- B. The installer shall designate an individual in his organization who is responsible for quality review and assurance that the work installed under this section of the work meets the quality standards established herein.

DELIVERY AND STORAGE

- A. Do not deliver casework until the location for which casework is to be installed has been climatized; humidity level changes do not exceed 20 percent and temperature changes do not exceed more than 15 degrees in any 24 hour period.
- B. Upon delivery, locate casework in each area where it is to be installed. Do not install cabinets where wet work has not been completed. Cover and protect from other trades.

WARRANTY

- A. Provide one year warranty protecting against defective materials and workmanship.

PART 2 PRODUCTS

MANUFACTURERS

- A. The drawings have been established using LSI Corporation of America, Inc. model numbers. Some model numbers may be modified to reflect certain requirements for this project. Where these modifications are different from the standard products furnished, deviations from these modifications will not be allowed. The following is a list of acceptable manufacturers of plastic laminated casework:
1. LSI Corporation of America, Inc. Minneapolis, MN, 612-559-4664
 2. Terrell Manufacturing Co., San Angelo, 915-655-7133
 3. Tru-Bilt, Calmar, IA 319-562-3261
 4. Case Systems, Midland, MI 517-835-7773
 5. Alpha & Omega Casework, Taylor, TX, 512-587-3771
 6. TMI, Dickinson, ND, 701-225-6716
 7. Westmark Products Inc., Tacoma WA, 206-531-3470
 8. Ameritek Designs, Inc. 281-442-7767
 9. Texas Woodwork Interiors
 10. Goebel Woodwork, Cuero TX, 361-277-5220
- B. Plastic Laminate Manufacturers (Basis-of-Design indicated on Material Schedule on drawings):
1. Nevamar
 2. Formica
 3. Wilsonart
 4. Pionite
 5. Lamin-art
- C. Particle Board: Shall have a minimum density of 45 lbs. per cubic foot with a moisture content no to exceed 8% and shall be mat formed three ply construction. Approved manufacturers:
1. Lousiana-Pacific
 2. Weyerhaeuser
 3. Temple-Eastex
 4. Kirby Forest Products
- D. Plywood: Shall be 7 ply veneer core 3/4" material and 9 ply for 1 1/8" material. Species shall be Douglas Fir. Grade shall be B faces with interior veneers grade C or better. Voids in interior cores exceeding 5 square inches will be subject to rejection. All plywood shall be manufactured in accordance with the U.S. Products Standards PS-1. All plywood shall be marked for exterior use and shall be adhered with waterproof glue. Where drawings or specifications indicate the use of plywood, particle board will not be accepted.
- E. Hardware:

1. Hinges shall be five knuckle 2 3/4" overlay type, .095 gauge with hospital tips. Provide a dull chrome US26D finish. Hinges shall be Gamblo Company, Inc. or equal Stanley. If alternate hinges are used approval of sample hinge will be required prior to placement of any casework on the project.
2. For doors less than 48" in height provide 2 hinges. For doors greater than 48" in height provide 4 hinges.
3. Pulls shall be Stanley 4484 US26D (equal Epcos M2-304 US26D)
4. Drawer slides in all cases shall maximize the clear inside depth of the case.
Manufacturers:
 - a. Knappe & Vogt
 - b. Grant
 - c. Accuride
 - d. Hafele
5. Heavy duty 50 lbs. rating equal to KV 1300SC.
6. File drawers shall be equipped with 100 lb. ratings, equal to KV 1429 full extension slides. All file drawers shall have file suspension brackets equal to Pendaflex File Frame Systems.
7. Magnetic Catches: Epcos 592-WS at all doors. Provide two catches for all doors in excess of 36" in height. Equal manufacturer: Stanley.
8. Shelf Supports: KV #347 or Hafele # 282.11.707 metal inserts spaces at 1 1/4" centers.
9. Locks: National M2-3704 construction core five pin tumbler lock keyed differently unless specified otherwise. Provide two keys per lock, master keyed, with a total of 6 master keys. Equal manufacturer: Best Lock Corporation.
10. Elbow catches at all inactive leaves shall be Ives 2A3.
11. Cloths Hanger Rod and Flanges shall be KV 660 rods with two #734 flanges.
12. Grommets: 2" as manufactured by Doug Mockett or equal.

F. Edging:

1. All exposed edges shall be covered with .020 or 3mm PVC applied with hot melt glue under heat and pressure to provide a complete seal. Color as selected by Architect. "T" barb edging will not be accepted.
2. Provide .020 PVC edge at all case bodies.
3. Provide 3mm edge at all doors, drawers, aprons, work surfaces and counter tops.
4. Colors as selected by the Architect from full range of colors to match plastic laminate.
 - a. One color will be selected for doors, drawers and aprons.
 - b. One color will be selected for countertops.

G. 1/4" hardwood plywood shall be stain grade 5 ply veneer core plywood used at all drawer bottoms, no exceptions.

LAMINATE FINISHES

- A. Decorative vertical surfacing laminate (.032) shall be at all exposed surfaces such as doors, drawers, exposed walls, open shelving units, ie., backs, shelves, and interiors of open cases.

- B. Decorative general purpose laminate (.055) shall be used at all countertops and backsplash surfaces. Where rolled edge or post-formed coved backsplashes are indicated provide post-forming grade plastic (.042).
- C. Cabinet liner (.030) shall be Wilson-Art #1573-CL "Solid Frosty White" or equivalent. No other color will be acceptable. The cabinet liner shall be used for balancing exterior surface laminates.
- D. Backer, .020" thick, shall be placed on all unexposed surfaces. And specifically at all undersides of countertops and backs of backsplashes. Backer shall be adhered to counters under heat and pressure.
- E. Pressure Fused Melamine Laminate, Frosty White in color shall be used in areas behind closed doors. Only High Quality Thermofused 80 to 100 gram PSM minimum Melamine will be accepted. Melamine must meet NEMA LD3-1991, GP-20, and ALA 1992 minimum performance standards, including 600 cycles in the Resistance to Wear Test and 19 to 20 inches in the Resistance to Impact Test. Note: Impact and Wear Test exceed minimum standards.

WORKMANSHIP

- A. All parts shall be machined for accurate fit and assembled with appropriate fasteners resulting in level and plumb units without discernable tool marks. Modified or special units shall be constructed with similar details.
- B. Cabinet Sub-base: To be separate and continuous (no cabinet bodies sides-to-floor). water resistant exterior grade plywood with concealed fastening to cabinet bottom. Ladder-type construction of unfinished fronts for the application of coved base material furnished by other sections.
- C. Schedule of Materials:
 - 1. Walls 3/4"
 - 2. Tops and Bottoms 3/4"
 - 3. Horizontal Dividers 3/4"
 - 4. Vertical Dividers 3/4"
 - 5. Shelves 1"
 - 6. Backs 3/8"
 - 7. Finished Back Panels 3/4"
 - 8. Countertops 1 1/8" (1 1/4" finished thickness)
 - 9. Backsplashes 3/4"
 - 10. Countertop Supports 1 1/4"
 - 11. Aprons 3/4"
 - 12. Toe Boards 3/4"
 - 13. Drawer Sides 1/2"
 - 14. Drawer Bottoms 1/4"
 - 15. Fillers 3/4"
- D. Drawer Construction:

1. Option 1: All drawers shall be constructed of minimum .50 inch hardwood sides, front and back assembled in drawer press with glued and doweled joinery. Drawer bottoms shall be 1/4 hardwood plywood matching species of drawer sides and shall be let into drawer sides, front and back. Provide a continuous bead of hot melt glue around perimeter of underside of drawer bottom firmly lock the drawer bottom in place. (Lacquer or C.L. finish at interior of drawer.)
2. Option 2: Fabricate all drawer boxes using 1/2 inch, 9-ply laminated hardwood plywood. The four corners of the drawers are machined for lock shoulder joints, glued, and stapled. The top edges of the drawer box sides and back are radiused. Drawer bottom is let in on four sides and securely glued underneath with a continuous bead of glue around the perimeter of the drawer bottom. Additional bottom braces are used on drawers over 24" wide. All components have one coat of clear waterproof sealer. Drawer boxes are screw-attached to separate drawer fronts.
3. Option 3: Drawer fronts shall be applied to separate drawer body component sub-front. Drawer sides shall be doweled and glued to receive front and back, machine squared and held under pressure, to set.

E. Note that at all sink cabinets, plywood cores shall be used as the substrate for both the cabinet and countertop.

UNITS

- A. Items of casework by room shall be as indicated on the drawings. Plan and/or elevations shall indicate casework to be provided.
- B. Manufacturer shall provide custom built units where indicated and as necessary to meet job conditions.

PART 3 EXECUTION

EXAMINATION

- A. Prior to shipment, the Casework manufacturer shall verify the casework structure is safe and stable when carrying the maximum intended loads, as measured against the load ratings of the fully extended, specified sliding drawer and shelf hardware. Verify that slide mounting surfaces are securely attached to the casework structure.

INSTALLATION

- A. All casework items shall be installed by the casework supplier at locations indicated in the drawings.
- B. Casework supplier shall make all cutouts necessary to receive plumbing items.
- C. Securely anchor wall units to surrounding walls. Take special care to assure that casework with sliding drawers and/or sliding shelves are securely anchored to prevent tip-over of the casework when fully loaded drawer or shelf is fully extended.
- D. Coordinate installation of work furnished by the various trades to assure properly functioning equipment at the completion of the job.
- E. Furnish scribe fillers required to complete the installation.
- F. Verify lengths of countertops, splashes, and bases. All tops 8'-0" or less to be one piece construction.

- H. Obtain appliance and equipment submittals from the General Contractor in order to coordinate opening sizes, etc. for equipment.

END OF SECTION 12 34 10

SECTION 20 00 00 - GENERAL PROVISIONS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. The work of Division 20-24 consists of providing labor, materials, products, and all operations required for the complete operating installation of ALL systems as shown and specified, in strict compliance with applicable drawings, specification, terms and conditions of the contract and all applicable codes and ordinances governing the installation of the various mechanical systems. Contractor shall provide all equipment and materials necessary and usually furnished in connection with such work and systems whether or not specifically mentioned in the specifications or on the drawings. All work is to meet individual product manufacturers written installation instructions. All work shall be fully correlated with the work of other crafts. This section of Division 20-24 is a part of all other sections of Division 20-24.
- B. Each Contractor shall study the Contract Documents included under this contract to determine exactly the extent of work provided under this contract, as well as to ascertain the difficulty to be encountered in performing the work on the drawings and outline hereinafter and in making new connections to existing utilities, installing new equipment and systems and coordinating the work with the other Trades.
- C. Notwithstanding any approvals or instructions which must be obtained by the Contractor from the Architect in connection with use of premises, the responsibility for the safe working conditions at the site shall remain that of the Contractor's, and the Architect or Owner shall not be deemed to have any responsibility or liability in connection therewith.
- D. The Agreement Forms, Uniform General Conditions, Supplementary Conditions, Division 00 and Division 01 of the specifications shall apply to the work specified in Division 20-24.
- E. Additional Site Visit Costs: Contractor shall be charged with any cost resulting from uncompleted items that require additional site trips by the Architect/Engineer.
- F. The Contractor shall obtain and pay for all permits and fees associated with his work.
- G. **NO TOXIC OR HAZARDOUS MATERIALS, INCLUDING BUT NOT LIMITED TO PRODUCTS OR MATERIALS CONTAINING ASBESTOS, PCB AND LEAD, SHALL BE PROVIDED OR INSTALLED. ALL ADHESIVES, SEALANTS AND COATINGS MUST MEET OR EXCEED GREEN BUILDING PROGRAM SCAQMD RULE 1168 AND 1113. ALL PAINTS MUST MEET VOC LIMIT OF GREEN SEAL ENVIRONMENTAL STANDARD GS-11. ALL INSULATION IS TO BE FREE OF UREA-FORMALDEHYDE AND/OR BE GREENGUARD CERTIFIED.**
- H. **An pdf copy of all Field Reports shall be kept in a separate notebook or pdf set up in the Construction Manager's Trailer. Contractors shall use these reports to check off that each individual item noted has been completed. Each item shall be initialed and noted when completed. Use this notebook to keep record of all test and results (i.e. wastewater test, water line tests, etc.**
- I. **Drawings:**
 - 1. **Architectural Background Files** – Architectural Revit Models and CAD files to be used for background files, MEP drawings are not background files. Architectural Revit Models and CAD files are used for shop drawings backgrounds. They must be obtained from the architect and cannot be given from the engineer. Reference Architect for cost of Architectural Files.

2. **MEP Drawings** – These drawings cannot be used for shop drawings, as they are diagrammatic in nature only. Actual shop drawings prepared by sub-contractors must be used for coordination between all trades. If MEP floorplan files are requested, they may be obtained with a signed confidentiality release form, only as outlined below. These files may be used in conjunction with this project only. There are no guarantees of compatibility or accuracy; all technical support will be billed hourly at current Engineer's Rates. Engineer does not charge for actual file but does charge for time required to prepare the files in format as requested by the Contractor. Fees will be based on Engineer's current hourly rates. Deposit of \$500 must be paid prior to beginning file preparation and balance must be paid prior to release of any files. Total fee based on actual time required by Contractor's request. See submittal and shop drawing section for additional information.
 3. **MEP CAD Files that will be released.**
 - a. If no Architectural RCP is available for light locations. Lighting Floorplans will be released.
 - b. Mechanical Floorplan will be released to Mechanical Contractor for aid in production of his own shop drawings. HCE mechanical drawings may not be submitted as shop drawings.
 - c. Fire Alarm/Fire Sprinkler/Intercom etc.... Contractors must use Architectural Backgrounds and Architectural RCP's (when available or lighting floorplan) and **Mechanical Contractor Shop Drawings** for coordination purposes. Do not request MEP floorplans, this portion of specifications will be cut and pasted into an email for you to read.
 4. Reference "**HCE BIM Protocols**" – document attached to the end of this section. It defines the expectations, limits and level of development of any 3D design tool, (if used) for any portion of a project design, to develop 2D bid documents. This applies to 3D design tool used by design teams as well as 3D design tool that may be requested by Contractor.
- J. **Site observation communication between Engineer and Contractors will be using online software. Contractors required to carry license for duration of project. Reference 3.09.**

1.02 MANDATORY PRE-CONSTRUCTION MEETING

- A. **DDC Contractor, Mechanical Contractor, Test and Balance Representative and representatives for each type of HVAC gear that requires interface beyond 'on/off' control will meet in the office of HCE or Online meeting (at discretion of Engineer) prior to initial control submittal. (if this meeting does not happen General Contractor to hold \$25,000 from payapp of each applicable subcontractor until it happens.)**
- B. **The purpose of this meeting is to introduce all representatives who will need to coordinate with each other to insure a working project.**
- C. **Each representative is to come prepared with sequences of operation, schematics and written instructions as to which points require what type of signal for each function and how tie-ins and integrations are to occur. If pulsed signals are required to keep a device on, bring it to the attention of the team and provide specific information. Do not assume others understand the inner workings of your gear or controls. Discuss exactly what type signals are acceptable to gear and how to set it up to receive and act on that signal so equipment and controls can be fully integrated by the contractor prior to final completion of the project.**

- D. **Newer multistage air volume split systems, RTU's, etc. have different sequences and control tie-ins than older conventional units. Exact requirements for a given type and brand of equipment must be coordinated by the equipment supplier with the Controls Contractor and with the Test and Balance Contractor.**
- E. **Test and Balance Contractor must verify air flow and delta T's across coils at every stage of unit capacity to insure that unit is providing the correct CFM based on the capacity stage it is on so that the unit does not end up with low stage cooling and high stage blower which will not dehumidify. Equipment supplier is to provide Test and Balance Contractor with a quick start up guide to show where and how to set up fan speed selections and outside air dampers so that only minor balancing occurs at dampers serving grilles. Discharge Air in ALL Cooling stages should be 56 degrees or lower.**

1.03 SITE INSPECTION

- A. Prior to bidding the Contractor shall visit and examine the site verifying all existing items and familiarize himself with existing work conditions and understand the conditions which affect performance of the work of this Division before submitting bids for this work. The submission of bids shall be deemed as evidence of such visits and examinations.
- B. All bids shall take the existing conditions into consideration and the lack of specific information on the drawings shall not relieve the Contractor of any responsibility. No subsequent allowance for time or money will be allowed for work or change related to failure to examine site conditions.

1.04 RELATED WORK SPECIFIED ELSEWHERE

- A. All work covered by this section of these specifications shall be accomplished in accordance with the respective drawings, information or instructions to bidders, and general provisions of these specifications. Any supplementary conditions, special conditions, addenda, or directives which may be issued by the Owner's representative herewith or otherwise shall be complied with in every respect.
 - 1. Electrical Specifications: Division 26-28.
 - 2. Mechanical, Electrical, Plumbing Drawings
- B. Unless otherwise indicated on the Electrical Drawings or in Mechanical Specifications, provide all mechanical equipment motors, motor starters, disconnect switches, thermal overload switches, control relays, time clocks, thermostats, motor valves, damper motors, electric switches, electric components, wiring, and any other miscellaneous Division 20-24 controls.
- C. Carefully coordinate all work with the electrical work shown and specified elsewhere in these documents.
- D. Motors: Furnish electric motors designed for the specific application and duty applied, and to deliver rated horsepower without exceeding temperature ratings when operated on power systems with a combined variation in voltage and frequency not more than plus or minus 10 percent of rated voltage.
- E. Verify from the drawings and specifications the available electrical supply characteristics and furnish equipment that will perform satisfactorily under the conditions shown and specified.
- F. Size motors for 1.15 service factor, not to exceed 40 degrees temp. Rise above ambient.
- G. Provide self-resetting thermal overload switch for fractional horsepower motors.

- H. Electrical Contractor to provide conduit and junction boxes for all sensors and exterior conduit for controls to mechanical equipment. Conduit for space sensor to extend from junction box to above accessible ceiling. Conduit for exterior equipment to extend from equipment through wall or roof to above an accessible ceiling. Any control wiring in exposed ceiling areas to be in conduit by Controls Contractor for protection. Controls Contractor to coordinate on all conduit requirements. Coordinate locations with Electrical Contractor.
- I. When Mechanical Contractor furnishes motor starter, provide each three-phase motor 25 HP and larger with phase failure and phase reversal monitoring relay in all three phases. Relay shall open motor starter contacts at 10% voltage unbalance and shall automatically reset when voltage returns to normal. Provide adjustable time delay set at .2 second on drop-out to prevent nuisance tripping on momentary voltage dips.
- J. Duct smoke detectors are to be provided in supply and return by Mechanical Contractor when there is no Fire Alarm Contractor. When Fire Alarm is present and Fire Alarm Contractor on job, Fire Alarm Contractor shall provide detectors, installed by Mechanical Contractor, tied into HVAC control circuit by Mechanical Contractor and to fire alarm panel by Fire Alarm Contractor.
- K. Duct smoke detector in supply and return air provided and installed by Mechanical Contractor for units over 2000 cfm and/or units serving rated egress pathways or as scheduled. Provide detectors with remote test switches and audible/visual indicators. Locate them beside unit thermostat unless otherwise noted.
- L. **The electrical design and electrical drawings are based on the equipment and/or electric motors of the type, size and electrical characteristics shown and specified on the mechanical drawings and any change in equipment and/or motor size or type brought on directly or indirectly by a substitution of mechanical equipment having characteristics requiring a change, shall be the responsibility of the Mechanical Contractor and the entire cost of such change, including conduit, wiring, motor starting equipment, etc., shall be paid for by the Mechanical Contractor at no additional charge, unless the substitution was initiated by the Owner. Submittals must clearly show any deviations. Mechanical Contractor is responsible for coordinating any required changes with the Electrical Contractor, prior to Electrical Contractors ordering of panels and associated equipment.**
- M. **Mechanical contractor assumes requirements of Controls Contractor when there is no separate Controls Sub-Contractor.**
- N. **High Wind Zones: Contractor shall be responsible for delegated design to secure ALL equipment/assemblies, ground or roof, so that they are secured/restrained per code for High Wind/Hurricane zones per the latest code maps.**

1.05 WORK NOT INCLUDED

- A. Certain labor, materials, or equipment may be provided under other sections of these specifications, by utility companies, or by the Owner. When such is the case, the extent, source, and description of these items will be as indicated on the Drawings or described in the specifications, but the Contractor is responsible for verifying with all parties involved as to the extent of his requirements of work.

1.06 SPECIFICATION TERMINOLOGY (Definitions)

- A. Streamlining: In many instances, the products, reference standards, and other itemized specifications have been listed without verbiage. In these cases, it is implied that the Contractor shall provide the products and perform in accordance with the references listed.

- B. "Furnish" means to purchase and deliver material as shown and specified, including mark-ups, and cart the material to an approved location at the site or elsewhere, as noted or agreed.
- C. "Provide/Install", as used in these specifications, means furnish all material, labor, sub-contracts, and appurtenances, including mark-up required for a complete, operating, finished system.
- D. "Rough-in and Connect Only" means provide an appropriate system connection, such as supplies with stops, continuous wastes with traps, shut-off valves required, and all piping connections, testing, etc., for proper operation, and to install equipment furnished. Equipment furnished is received, uncrated, assembled and set in place by supporting crafts unless they make prior arrangements to hire the mechanical installer for this work.
- E. "Accessible" means arranged so that an appropriately dressed maintenance man may approach the area in question with tools and products necessary for the work intended and may then position himself to properly perform the task to be accomplished, without disassembly or damage to the surrounding installation. It shall also be no more than four feet (4') above a ceiling.
- F. "Serviceable" means arranged so that the component or product in question may be properly removed, and replaced without disassembly, destruction, or damage to the surrounding installation.
- G. "Product" is a generic term which includes materials, equipment, fixtures, and any physical item used on the project.
- H. Wherever the term "shown on drawings" is used in the specifications, it shall mean "noted", "indicated", "scheduled", "detailed", or any other diagrammatic or written reference made on the drawings.
- I. "Conduit" includes, in addition to conduit, all fittings, hangers and other accessories relative to such conduit. "Piping" includes, in addition to piping, all fittings, valves, hangers and other accessories relative to such piping.
- J. "Concealed" means hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction, crawl spaces, etc.

1.07 DIAGRAMMATIC DRAWINGS

- A. Drawings and specifications encompass a system that will integrate with the structural, electrical, plumbing, mechanical, civil, technology, architectural design and all design sub-consultants of the building. Reference ALL disciplines sets of drawings for complete scope of work.
 - 1. Drawings and specifications are complementary, each to the other; what is shown on one is as binding as if called for in both.
 - 2. Where drawing details, plans, and/or specification requirements are in conflict, and where conduit, duct and piping sizes of the same run are shown to be different between plans and specifications or details, the most stringent requirement will be included in the Contract. Systems and equipment called for in the specification and/or shown on the drawings shall be provided under the contract of each Trade as if it were required by both the drawings and the specifications. However, prior to ordering or installation of any portion of work which appears to be in conflict, such work shall be brought to the Architect's attention for direction as to what is to be provided.
- B. The drawings are partly diagrammatic in character and do not show exact locations, all offsets, or give exact elevation in piping, fittings, duct, conduits, etc. Also, the drawings do not necessarily show in minute detail all features of the installation. Contractor is to install all products coming with

manufacturer's written instructions and installation details per the manufacturer's instructions, unless specifically instructed to deviate by project engineer. Contact engineer for direction if conflicts occur for direction. Contractor shall physically arrange the systems to fit in the space available and shall carefully investigate structural and finish conditions, arrange work accordingly and provide a complete and satisfactorily working installation. Provide all work shown on the drawings and specified, unless otherwise stated. No subsequent allowance will be made due to failure to coordinate work prior to installation.

- C. Plumbing Piping and Fixtures – Plumbing Pipes are partially diagrammatic in nature. Plumbing mains and distribution pipes are shown and sized, individual taps for fixtures are to be provided at every location a fixture is shown on plumbing and architectural sheets. Even if not specifically drawn it is implied that EVERY plumbing fixture have the connections called out on 'Pipe Sizing Requirements' and 'Fixture Connection Schedule' and as required from manufactures installation instructions. Hot water tap and shutoff valve above ceiling, cold water tap and shutoff valve above ceiling, waste connection, vent connection, etc. Gang restrooms shall have shut off valve in hallway for the following pipes feeding chase, cold water feed, hot water feed and balancing valve on the hot water recirculation line leaving the chase. All fixtures require shut-off valves for individual fixtures except as called out for gang restrooms with chase feed.
- D. The Architectural, Structural, Civil and Electrical plans and Specifications and other pertinent documents issued by the Architect are a part of these Specifications and the accompanying Mechanical Drawings and shall be complied and coordinated with in every respect. All drawings and specifications mentioned above shall be examined by all bidders. Failure to examine all drawings for coordination and quantities shall not relieve the Contractor of responsibility and no subsequent allowance for time or money will be allowed.

1.08 MATERIAL AND EQUIPMENT SUBMITTALS

- A. Submittals: Provide submittals for all products and systems described in Division 20-24 and shown on the drawings to demonstrate compliance with the requirements of the project. Furnish equipment submittals in the manner described elsewhere in these specifications.
- B. Submit to the Engineer, after the award of the contract or as dictated by project schedule, a type written list of those items of equipment and appurtenances which will be furnished. Include the name or description of the item, name of manufacturer, model or type, catalog number and manufacturer's printed information. The information submitted shall include overall dimensions, weights, voltage rating, phase, wiring diagrams, etc., and nameplate data. Assemble cut sheets into separate submittals as defined in this section or by Specification Section. Submit priority items and long lead time first. Then follow with remaining items. This will allow for faster review and response to accommodate project schedule. **Any submittal with all sections under one (1) cover will be returned and required to be broken into separate submittals.** The Engineer's check will be general and does not relieve the Contractor of final responsibility to comply with the Contract Documents in all respects.
- C. Submittal Review Time – In order to provide the most efficient submittal review and to cut down delays of equipment with long lead times, the Engineer requests the Contractor Provide a Submittal Schedule at the beginning of the job within 20 days of contract award. At the beginning of the project the contractor is to review job schedule and material lead times. Based on that information the Contractor shall put together a reasonable schedule of dates that each submittal is needed to be returned in order of importance, to order materials. ALL submittals, with separate covers and identifiers shall be submitted to the design team as early in the projects as possible. The design team can NOT practically review ALL submittals at once in 2 weeks, but the design team can schedule review time for all submittals in priority order, based on the Contractor provided Submittal Schedule, to be returned to contractor prior to the requested schedule date from the contractor. Submittals that are haphazardly submitted late in the project cycle creating artificial time emergencies are not the responsibility of the Engineer to provide unreasonable expedited review.

Complicated submittals require extended review time, and this should be taken into account. Submittal review time requested only applies to standard workdays, and excludes weekends and holidays. Extended company holidays are typical at Thanksgiving Wednesday-Friday and the final 2 weeks of the year at Christmas and New Year, our office is closed. These times frames should be considered while producing the required Submittal Schedule.

- D. Submittal review is for general design and arrangement only and does not relieve the Contractor from any of the requirements of the Contract Documents. Submittals will not be checked for quantity, dimension, fit or proper technical design of manufactured equipment. Where deviations of substitute product or system performance have not been specifically noted in the submittal by the Contractor, provision of a complete and satisfactory working installation is the sole responsibility of the Contractor. **Warranties cannot be reduced through the submittal process.**
- E. **Contractor shall indicate items being used on cut sheets by highlighting or arrowing to actual part number. Submittals may be returned without checking if submittals not appropriately marked.**
- F. **'Individual submittals' means separate submittals with unique submittal numbers for each specification section. Separate PDFs for each Submittal number.**
- G. **HARDCOPY SUBMITTAL REQUIREMENT: Hardcopy submittals will not be required by Engineer.**
- H. **PDF SUBMITTAL REQUIREMENT:**
1. For submittal sections listed below as allowed pdf's the following requirements must be met, or the submittal will not get through email security and will be auto deleted and not checked. Each specifications section must be a separate pdf file, **one giant pdf for all sections will be rejected.**
 2. **PDF FILE: MUST BE NAMED AS FOLLOWS:**

JOB NAME – SUBMITTAL No. XX – SUBMITTAL DESCRIPTION
 3. **EMAIL TITLE/SUBJECT: FOR SUBMITTALS MUST BE AS FOLLOWS:**

JOB NAME – SUBMITTAL No. XX – SUBMITTAL DESCRIPTION
 4. Failure to follow these instructions will result in the submittal never reaching the engineer and not being checked. Delays caused by not following these procedures are the sole responsibility of the contractor. Emailed submittals must come from the Architect and must not be emailed directly from the contractor. Do not Carbon Copy the Engineer on Emailed submittals.
- I. **Multiple re-reviews required due to Contractor not following instructions, specifications, etc. will be billed to Contractor at Engineer's current hourly rates. This shall be paid prior to submittal approval.**
- J. **SUBMITTALS WILL BE RETURNED IN ORDER OF CONSTRUCTION OF THE PROJECT, NOT NECESSARILY IN ORDER SUBMITTED.** If all sections are submitted under one binder and transmittal, each section will be returned at the appropriate time for construction phasing. Mechanical Equipment will not be reviewed until "Mechanical/Electrical Coordination Sheet" has been submitted. Mechanical Equipment, Mechanical Controls and Plumbing Fixtures may require extended review time. **IF SUBMITTALS ARE SUBMITTED EARLY RELATIVE TO CONSTRUCTION PHASING, SUBMITTALS MAY BE HELD, REVIEWED AND RETURNED AT**

THE APPROPRIATE TIME FOR CONSTRUCTION PHASING, NOT NECESSARILY 2 WEEKS.

- K. **DO NOT SUBMIT THE FOLLOWING SECTIONS UNLESS DEVIATING FROM THE SCHEDULES/SPECIFICATIONS. Provide directly to General Contractor/CMR for inclusion into O & M Manuals. If deviating from the specifications, submittal will be required. Deviations must be noted on Transmittal and highlighted in submittal. (Write summary sheet of deviations and highlight items that are different to allow for proper review.):**

1. 20 01 00 – Basic Materials and Methods – Only items listed
 - ♦ Valve Tag / Markers
 - ♦ Access Panels / Doors
 - ♦ Pipe Identification / Labels
 - ♦ Valves
 - ♦ Fire Proofing/Fire Caulk

- L. **PDF Submittals** for the following items:

Separate PDF for each Submittal number is required.

1. 20 00 00 – General Provisions
 - ♦ Mechanical/Electrical Coordination Sheet
 - ♦ Plumbing/Electrical Coordination Sheet
 - ♦ Ductwork Shop Drawings
 - ♦ Return Air Path Shop Drawings
 - ♦ Plumbing Piping Shop Drawings
2. 20 01 00 – Basic Materials and Methods
 - ♦ All items not excluded above
3. 20 07 00 – Insulation
4. 21 00 00 – Fire Sprinkler Product Data
5. 22 11 16 – Water Distribution Systems
6. 22 11 17 – Water Heaters
7. 22 13 16 – Liquid Waste Transfer
8. 22 30 00 - Plumbing Fixtures and Trim
9. 23 09 XX – Controls
10. 23 05 93 – Test and Balance Report
11. 23 08 02 – Equipment Start-Up reports
12. 23 30 00 – Air Distribution

13. 23 70 XX – Mechanical HVAC Equipment

M. **Data Required for Review: Mark submittal literature and shop drawings clearly by individual sections, and include all equipment and material shown on drawings and specified. ANY DATA NOT CLEARLY MARKED OR NOT APPROPRIATELY SUBMITTED WILL BE RETURNED WITHOUT CHECKING. Indicate the following:**

1. Specification reference and/or drawing reference for which literature is submitted for review with an index, following specification format, and item by item identification.
2. Manufacturer's name and address, and supplier's name, address, and phone number.
3. Catalog designation or model number.
4. Rough-in data and dimensions.
5. Performance curves and rated capacities with performance data marked.
6. Motor characteristics and wiring diagrams.
7. Operation characteristics.
8. Complete customized listing of equipment, characteristics, accessories, etc., specified. Indicate whether item is "As specified." Mark out all non-applicable items. The terminology "As specified" used without this customized listing is not acceptable.
9. Wiring diagrams for the specific system operation. Complete wiring with diagrams showing all connections to each type of actual equipment being installed on project, complete with part numbers of controls for each type of equipment.
10. **Equipment manufacturer/vendor must submit written sequence of operation for all modes of operation for each piece of mechanical equipment with the equipment submittal. Give narrative explaining exactly what control signals are required to activate each mode of a particular unit's operation. Include information about which signals override others internally (when applicable). Submit this information with equipment submittal and provide a copy to the Controls Contractor so it can be integrated into the control scheme and control submittals. Indicate whether 24 VAC, 4-20 MA, 0-10VDC or line voltage is required for controls.**
11. **Provide HVAC equipment with a controls interface that is suitable for connection to a standard conventional thermostat and/or non-proprietary DDC control systems unless it is SPECIFICALLY scheduled otherwise.**
12. **Ductwork Shop Drawings: Engineer requires PDF, full-size at 1/8" scale, sheets size to match project for engineer review and engineer records. Additional copies per Architect and Owner requirements. PDF's will be required for owner and architect records.**
13. **BREAKOUT SUBMITTALS INTO PRIORITY ITEMS.**

N. **Contractor to submit "Mechanical/Electrical Equipment Coordination Sheet" with equipment submittal for all electrified mechanical equipment, including but not limited to: MAU, RTU, VAV, FP, RTU-VAV, CHILLER, PUMP AHU, CU, HP, HRU, CC, ERV and HETD, etc... Reference chart at end of section.**

1. The Mechanical Contractor is to use the "Mech/Elect Coordination Sheet" found in Specification Section 20 00 00 to coordinate the electrical requirements of the mechanical equipment with the Electrical Contractor. This applies to all mechanical equipment, not just VRF equipment.
 2. The Mechanical Contractor is to submit a copy of the completed Coordination Sheet that has been reviewed and signed by the Electrical Contractor.
 3. Mechanical equipment submittal will be rejected and returned if submitted without a Coordination Sheet that has been signed by the Electrical Contractor. A copy of the Coordination Sheet should be attached to each separate mechanical equipment submittal.
 4. The Mechanical Contractor is responsible for any cost associated with changes in electrical requirements if alternate equipment (equipment not scheduled on plans) is provided on this project. This includes equipment that may be listed as equal or as an approved alternate.
 5. The Electrical Contractor is to verify that the scheduled electrical voltage and phase is available on site.
 6. The Electrical Contractor is to provide the MOCP (maximum over current protection) listed on the Coordination Sheet. As well as wire size with ampacity equal to or greater than the listed MOCP.
 7. An approved submittal does not release the contractors from coordinating the mechanical equipment and associated electrical service to provide the Owner with a complete and operable system.
- O. When requested, present samples of all materials proposed for use to the Engineer for his approval.
- P. Certify Shop Drawings have been checked for compliance with Contract Documents and coordinated with other trades. Certify that the materials submitted can be delivered and installed according to the construction schedule.
- Q. Select all other materials, not specifically described on the Drawings or in these specifications but required for a complete and operable facility and submit to the Engineer for approval.
- R. **Substitutions:** ("Substitution Request" form must be submitted)
1. Equipment listed as equal is indicated to be equal in quality to equipment designed around. It does not mean equal in dimension or fit. It is the Contractor's responsibility to confirm dimensional differences and space requirements.
 2. Request for proposed substitution of materials, methods, or processes shall be made to the Architect a minimum of ten (10) days prior to bid date and if found acceptable, will be confirmed by an addendum to the Construction Documents. Where proposed substitutions are not incorporated into the Construction Documents by addendum **PRIOR** to time of the General Contract bid opening, all bids shall be held to have been made on the basis of the materials, methods and processes required by the Construction Documents.
 3. When contractor is requesting a substitution prior to bid, request permission in writing from the Engineer still using "Substitution Request" form.

- a. In the request for substitution, state the amount of adjustment to be made in the contract price in order to give the Owner the benefit of any savings in materials or labor costs.
 - b. All substitutions shall be of equal or better quality to the equipment specified.
4. **Equal Materials:** It is not the intent of the Specifications to limit materials to the product of any particular manufacturer. Where definite materials, equipment and/or fixtures have been specified by name, manufacturer, or catalog number, it has been done so as to set a definite standard and a reference for comparison as to quality, application, physical conformity, and other characteristics.
 5. Acceptance of substitution by the Engineer does not relieve the Contractor of responsibility for proper operation of the systems, compliance with specifications, necessary changes due to dimensional differences or space requirements, and of work on schedule.
 6. Where equipment of the acceptable manufacturers requires different arrangement or connections from those shown, it shall be the responsibility of the Contractor to install the equipment to operate properly and in harmony with the original intent of the drawings and specifications. When directed by the Architect, the Contractor proposing substitutions shall submit drawings showing the proposed installation. If the proposed installation is approved, the Contractor shall make all necessary changes in all affected related work provided under other Sections, including location of rough-in connections by other Trades, conduit supports, insulation, etc. All changes shall be made at no increase in the Contract amount or additional cost to the other Trades and/or Owner.
 7. **Submit fully completed "Substitution Request" form located at end of this section. If this form is not submitted, all substitution requests will be automatically rejected.**
 8. **For substitutions that require substantial review by engineer to ensure equality, the contractor requesting substitutions shall reimburse the engineer at current hourly rates for all review time. This shall be paid prior to submittal approval. This applies to all equipment not previously approved on construction documents.**
 - a. Mechanical Equipment
 - b. Contractor Cost Savings Packages Requiring Substantial Review Time

1.09 SHOP DRAWINGS REQUIRED

- A. **Prepare and submit working construction drawings as requested, specified, and otherwise necessary to demonstrate proper planning for installation and arrangement of all work. Layout drawings to scale and show dimensions where accuracy of location is necessary for coordination or communication purposes. Show work of all trades, including Architectural, Structural, Mechanical, and Electrical items which may be pertinent to proper and accurate coordination. Provide shop drawings for all products, ductwork, systems, system components and special supports which are not standard catalog products, and which may be fabricated for the Contractor or by the Contractor. Show top and bottom elevation of ductwork and equipment as it will be installed. Show offsets required to miss structural and other items of interference. Identify all shop drawings as to which section and paragraph of the specifications and/or drawing number the item is covered under. Ductwork layout/shop drawings to be done at a minimum 1/8" = 1'-0" scale. AHU's, CU's, HP's, RTU's, etc. are to be shown actual scaled size and configuration of the actual equipment being used.**

- B. **Plumbing Piping shop drawing required –**
1. **Waste piping with starting inverts and inverts at civil connections. For coordination with structural slabs and beams and civil connections. Show approximate VTR locations and sizes for coordination with Mechanical Contractor outside air intake.**
 2. **HW and CW piping mains and indicate any penetrations through slab for coordination with structural and civil contractors.**
 3. **Electrical Panel Locations.**
 4. **Cable tray locations**
 5. **Above ceiling mechanical equipment, including 36” horizontal working clearance on access side.**
- C. Architectural Revit Models and CAD files to be used for backgrounds in preparation of ductwork and sprinkler shop drawings and shall be obtained from the Architect. Confirm requirements and stipulations for obtaining floor plan backgrounds with Architect and with other sections of specification. Engineer's drawings and CAD files **may not** be used for Shop Drawings. Reference 1.01,J.
- D. ALL SHOP DRAWINGS OF MECHANICAL ROOMS/MEZZANINES SHALL SHOW ALL FLOOR DRAINS, HVAC, PLUMBING, AND ELECTRICAL EQUIPMENT, INCLUDING ELECTRIC PANELS, TRANSFORMERS AND DISCONNECT SWITCH LOCATIONS. COORDINATE WITH ELECTRICAL AND PLUMBING CONTRACTOR.
- E. Provide roof shop drawing indicating dimensioned locations and sizes for all roof mounted equipment, supports, openings and plumbing vents in ample time for proper coordination of all trades.
- F. Submission of copies of the Engineer's drawings does not constitute shop drawings and is not acceptable.
- G. Submittal of complete engineering submittal data for products and equipment shall be made in. Provide an electronic copy in PDF format and CAD if available for record keeping purposes for Engineer, Architect, and Owner with close out documents described elsewhere in specifications.
- H. **General Contractor shall transmit a CAD copy of ductwork shop drawings to sprinkler contractor prior to submission of sprinkler shop drawings.**
- I. **General Contractor shall transmit a CAD copy of ductwork shop drawings to plumbing contractor prior to submission of piping shop drawings.**
- J. Ductwork shop drawings shall be submitted and reviewed prior to any ductwork being installed. If shop drawings are not provided or fully coordinated with all trades, existing conditions or new conditions, the Mechanical Contractor and his subcontractors will not be compensated for any changes required to be made to allow for proper fit or routing of all systems, including systems provided by other trades. The Contract Documents are diagrammatic in nature and are intended to convey the overall design of the MEP systems and are not intended to be used as Shop Drawings. Duct Shop Drawings are to be provided by the Mechanical Contractor and should include all work that will be installed near mechanical work but performed by other trades, including but not limited to ductwork, mechanical, plumbing, and electrical equipment, all piping including fire sprinkler, condensate and refrigerant piping, structural members, architectural elements, cable etc. The Mechanical Contractor is responsible for looking at all Contract Documents by all disciplines as well

as existing conditions for remodels or additions to existing building prior to bid. Any modifications that need to be made from what is shown on the Contract Documents is the responsibility of the Mechanical Contractor.

- K. Plenum Return Air Path Shop Drawing Submittal:
1. Walls to deck without proper transfer openings pose serious restrictions to return air flow, this hampers HVAC performance. Every attempt is made to show transfer openings in penetrable walls (not rated stairway or science room, wall, etc.) known to go up to deck during design. In order to insure full return paths are maintained during construction the following coordination is required. Prior to wall construction the General Contractor and Mechanical Contractor are to mark up mechanical floor plan(s) highlighting in yellow where any wall will go to deck. Indicate a bulkhead or anything similar going to deck above ceiling level in blue highlighting. Indicate fire/smoke walls with orange highlighting and indicate transfer openings with green highlighting. Provide copy to Engineer a minimum of 3 weeks prior to gyp being installed on walls for instructions on where to add additional wall openings and size required for proper transfer of return air. When additional walls or things like bulkheads are run to deck additional transfer openings must be created. It is contractor's responsibility to insure that there is a sufficient air path around or through such obstacles. Any not caught during construction are to be added at no additional cost post construction as required. Passing an above ceiling inspection does not relieve this requirement. Ducted transfers are not required when a given wall does not actually go to deck, even when a transfer is shown. This work and coordination is to be included in bid and is to be done at no additional cost to Owner. Contact Engineer for guidance as needed.
- L. **MECHANICAL CONTRACTOR MUST SUBMIT "MECHANICAL/ELECTRICAL COORDINATION SHEET" WITH MECHANICAL EQUIPMENT SUBMITTAL FOR PROPER COORDINATION PURPOSES WITH ELECTRICAL CONTRACTOR FOR ACTUAL EQUIPMENT BEING INSTALLED OR SUBMITTAL WILL BE REJECTED.**
- M. **PLUMBING CONTRACTOR MUST SUBMIT "PLUMBING/ELECTRICAL COORDINATION SHEET" WITH PLUMBING EQUIPMENT SUBMITTAL FOR PROPER COORDINATION PURPOSES WITH ELECTRICAL CONTRACTOR FOR ACTUAL EQUIPMENT BEING INSTALLED OR SUBMITTAL WILL BE REJECTED.**

1.10 RECORD DRAWINGS

- A. Reference requirements stated elsewhere in the Specifications. Where drawings are referenced, it is considered synonymous with pdf drawings or pdf prints.
- B. THE CONTRACTOR SHALL TAPE ALL ADDENDA'S ISSUED DURING BIDDING TO HIS CONSTRUCTION AND RECORD DRAWING SET PRIOR TO COMMENCING CONSTRUCTION. PAY REQUESTS WILL NOT BE PROCESSED UNTIL THE CONTRACTOR HAS COMPLIED WITH THIS REQUIREMENT.
- C. In addition to other requirements, a master Record Drawing print set (separate from field sets) shall be kept in the General's site trailer and marked up weekly as the work progresses, to show exact dimensioned location and routing of all mechanical work which will be permanently concealed. Show routing and location of items cast in concrete or buried underground. Work located in spaces with access, or above suspended ceilings, is not considered permanently concealed. Show complete routing and sizing of any significant revisions to the systems shown. Show the location of all valves and their appropriate tag identification. Indicate locations of all existing active and inactive piping uncovered during construction. **Keep marked up set at site for review at site meetings.**

- D. The marked-up and colored-up prints will be used as a guide for determining the progress of the work installed for draw requests. They shall be inspected periodically by the Architect and Owner's Representatives, and they shall be corrected immediately if found either inaccurate or incomplete. **This procedure is mandatory.**
- E. The Contractor shall be responsible for updating and/or marking all items, including but not limited to floor plan changes, system changes, addendums, change orders, etc. on the prints to "As-Built" conditions. At the completion of the job, marked up As-Built Drawings shall be submitted to the Architect for final review and comment. These corrected prints together with corrected prints indicating all the revisions, additions, and deletions of work, shall form the basis for preparing a set of record drawings.
- F. Using the "Record Drawing Set", the Contractor shall print two (2) complete sets of prints, one for submission to the Owner and one rolled in a 4" PVC pipe in main electric room mounted to wall and labeled. Tape all edges. The contractor shall provide pdf copies/scans for owner record purposes.
- G. The Contractor shall bear all the costs of producing the "Record Drawing Set".
- H. All equipment's **model and serial numbers** must be included on start up forms turned in to the owner. For split systems, this includes all model and serial numbers for all indoor sections or components as well as outdoor units. These are required for owner inventory and for processing of any utility rebate forms. Utility rebates require the model and serial numbers associated with a given unit number to match, in case the job is spot checked prior to issuing a rebate.

1.11 CODES, REGULATIONS AND ORDINANCES

- A. All work shall comply with the current applicable local, state, and federal codes and ordinances. Follow recommended practices as set down by ASME, SMACNA, ASHRAE, NFPA, applicable Building Code, applicable Mechanical Code, applicable Plumbing Code, National Electrical Code (NEC), AGA, ADA, AND OSHA, as they apply to this project, except in cases where local statutes govern. The contractor shall verify with the latest adopted local codes, ordinances and amendments that apply to this project with the authority having jurisdiction. **PROVIDE LOCKING REFRIGERATION ACCESS PORT CAPS FOR ALL EQUIPMENT WITH REFRIGERANT LOCATED OUTDOORS ON GROUND OR ON ROOF.**
- B. In cases of difference between Building Codes, State Laws, Local Ordinances and Industry Standards and the Contract Documents, each Subcontractor shall promptly notify the Architect in writing of any such difference, as applicable to his work.
- C. In case of conflict between the Contract Documents and the requirements of any Code or Authorities having jurisdiction, the most stringent requirements of the aforementioned shall govern.
- D. Should the Contractor perform any work that does not comply with the requirements of the applicable Building codes, State laws, Local Ordinances, and Industry Standards, he shall bear all costs arising in correcting the deficiencies, as approved by the Architect.

1.12 DELIVERY AND STORAGE OF EQUIPMENT AND MATERIAL

- A. **All equipment and materials shall be protected from physical, moisture absorption, metallic corrosion, and weather damage from the time of delivery until completion of the project. This includes erection of temporary shelters and covering items in the building with protective covering. Store items subject to moisture damage such as insulated curbs in dry locations. Items such as controls in dry, heated space. Failure to comply with the above to the satisfaction of the Owner/Architect will be sufficient cause for the rejection of the equipment or material in question. Upon such rejection, the damaged equipment or**

material will be completely replaced with new by the Contractor at no charge to the Owner.

- B. **Provide covers on all ends and openings of pipes, conduits, ducts, etc. to keep out insects, dirt, dust, and debris during entire construction process. This includes properly covering unassembled ductwork, etc. stored on jobsite prior to installation.**
- C. The Manufacturer's directions are to be followed from delivery, storage, protection and installation of equipment and materials. Notify the Architect in writing of conflicts between requirements of Contract Documents and manufacturer's direction.
- D. Large pieces of equipment which are too large to permit access through doors, stairways or access opening shall be placed in the space before enclosing the structure. After equipment is placed, it shall be thoroughly protected from damage.

1.13 CLEAN-UP

- A. Remove debris and waste materials from within the construction areas and transport off-site, daily.
- B. Keep the construction area clean, free from hazard, and orderly arranged.
- C. Pay all costs of waste removal and disposal. Reference General Conditions for further information.
- D. Dispose of waste materials in accordance with all regulations which govern.
- E. Take all precautions to protect persons who enter the construction area from hazardous conditions, hazardous waste, toxic waste, or other unsafe conditions.
- F. Upon completion of construction, remove all debris, waste materials, unused materials, temporary constructions, vehicles, tools, fencing, etc. to Owner's satisfaction.
- G. All equipment and materials shall be protected from physical moisture absorption, metallic corrosion and weather damage from time of delivery to completion of project. Replace any damaged materials.

PART 2 – PRODUCTS

2.01 EQUIPMENT AND MATERIALS

- A. Unless otherwise indicated, provide only new equipment and materials.
- B. On all major equipment components, provide manufacturer's name, address, model number, and serial number permanently attached in a conspicuous location.
- C. All materials furnished under these specifications shall be the standard product of manufacturers regularly engaged in the production of such equipment and shall be the manufacturer's latest approved standard design.
- D. **GUARANTEE**
 - 1. The Contractor and Manufacturers shall provide a TWO (2) YEAR guarantee for all work under the Electrical, HVAC, Plumbing and Fire Protection Trade. However, such guarantees shall be in addition to and not in lieu of all other liabilities which the manufacturer and Contractor may have by law or by other provisions of the Contract Documents. **In any case, such guarantees and warranties shall commence when the**

Owner accepts the mechanical/electrical system, as determined by the Architect.

2. All materials, items of equipment and workmanship furnished under each Section shall carry a TWO (2) YEAR warranty against all defects in material and workmanship. Any fault under any Contract, due to defective or improper material, equipment, workmanship or design which may develop shall be made good, forthwith, by and at the expense of the Contractor for the work under his Contract, including all other damage done to areas, materials and other system resulting from this failure.
3. The Contractor shall guarantee that all elements of the system, which are to be provided under his Contract, are of sufficient capacity to meet the specified performance requirements as set forth herein or as indicated.
4. Upon receipt of notice from the Owner of failure of any part of any systems or equipment during the guarantee period, the affected part or parts shall be replaced by the Contractor for his respective work, as applicable.
5. Additional extended guarantees required for work on this project. The additions and/or extensions to the standard one-year guarantee previously described are to be provided in writing, by the manufacturer or an approved insurance underwriter. The guarantee is to cover all parts and/or labor as specified below.

Master Extended Guarantee List:

- a. Gas heat exchangers in all furnaces, make-up air heaters, "neutral air" make-up air units (MAU), unit heaters and packaged rooftop units (RTU) to have an additional nine (9) year parts only guarantee. (Non-prorated) Total 10 year max.
- b. All comfort air conditioning and heat pump compressors are to have an additional four (4) year parts only guarantee. (Non-prorated) Total 5 year max.
- c. All computer grade HVAC equipment compressors are to have an additional one (1) year parts only guarantee. (Non-prorated)
- d. All "neutral air" make-up air units (MAU) are to have the following additional guarantees (Non-prorated):
 - 1) Two (2) year total unit performance.
 - 2) Additional four (4) year parts on compressors.
 - 3) Additional four (4) year parts and performance on total enthalpy and sensible recovery cores, wheels, heat pipes, plate and frame exchangers and run around loops.
 - 4) Provide unit with one (1) spare belt for each fan and wheel to be used at Owner's discretion after the guarantee period expires.
 - 5) Additional one (1) year parts and labor on entire make-up air unit package against water leaking into the unit and/or into the building through any roof curb mounted unit. Manufacturer's representative is to certify proper installation on each unit in writing.
- e. All VRV/VRF style equipment to have ten (10) year parts and labor warranty, period. Any training or start-up by vendor is included in job.

6. Furnish, before the final payment is made, a written guarantee covering the above requirements.
7. Additional/extended guarantees listed above are Non-negotiable and can't be amended through the submittal process.

PART 3 - EXECUTION

3.01 CUTTING AND PATCHING

- A. The Contractor shall notify the General Contractor and other Subcontractors in ample time of the location of all chases, sleeves and openings required in the construction for the proper installation of his work. The Contractor shall do all core drilling of individual holes and all cutting for his work, except square or rectangular openings in the structural slabs, which shall be cut by the Contractor at locations shown on the drawings. In no case, however, shall a beam or column be cut without the approval of the Project Structural Engineer.
- B. On completion of this work or as work progresses, the Contractor shall make all repairs and do all patching required as a result of the work under this contract. All patching shall be performed in a manner that will restore the surrounding work to its original conditions and to the satisfaction of the Owner.
- C. Any cutting and patching necessary as a result of the Contractor's failure to notify the General Contractor of all the required openings, shall be at the expense of the Contractor.

3.02 OBLIGATIONS/RESPONSIBILITIES

- A. The Contractor binds himself, his partners, successors, assigns and legal representatives to the Owner in respect to all covenants, agreements and obligations contained in the Contract Documents. The Contractor shall not assign the Contract or sublet it, as a whole, without the written consent of the Architect/Owner, nor shall the Contractor assign any monies due or to become due to him hereunder, without the previous written consent of the Owner/Architect.
- B. The Contractor shall supervise and direct the Work using his best skill and attention. He shall be solely responsible for all construction means, methods, techniques, safety, sequences and procedures, and for coordinating all portions of the work under his Contract.
- C. The Contractor shall provide, without extra charge, all incidental items required as a part of the work, even though not particularly specified or indicated, and if he has good reason for objecting to the use of a material, appliance, or type of construction shown or specified, he shall register his objections with the Architect/Engineer, in writing; otherwise, he shall proceed with the work under the stipulation that a satisfactory job is required.

3.03 TESTS AND INSPECTIONS

- A. Schedule, obtain, and pay for all fees and/or services required by local authorities and by these specifications, to test the mechanical systems as specified in these specifications.
- B. Request for Tests: Notify the Architect a minimum of 24 hours in advance of tests. In the event the Architect does not witness the test, certify in writing that all specified tests have been made in accordance with the specifications.

- C. Deficiencies: Immediately correct all deficiencies which are evidenced during the test and repeat test until system is approved. Do not cover or conceal piping, equipment, or other portions of the mechanical installations until satisfactory tests are made and approved.
- D. Operating Tests: Upon request from the Architect, place the entire mechanical installation and/or any portion thereof, in operation to demonstrate satisfactory operation.
- E. Log of Tests: The Contractor shall set up a testing log form to be kept at the job site with the record drawings. All tests shall have pertinent data logged at the time of testing. Pertinent data is to include date, time, description, personnel, system tested (and extent), test conditions, test results, etc.
- F. Completion: Upon completion of the mechanical installation, demonstrate to the Architect's satisfaction that the systems have been installed in a satisfactory manner in accordance with the plans, specifications, and applicable codes. Demonstrate dynamic operation of all systems. Show that all controls are operable and are properly adjusted in accordance with the requirements of the final systems balance, that all systems are properly balanced, that all equipment operates properly, that filters and strainers are clean, and that all components of all systems are installed and adjusted for proper operation.
 - 1. Prior to final inspection, all work under this Division to be completed. Insure all equipment is operational and final testing and balance reports have been submitted and approved.
- G. COMMISSIONING REQUIREMENTS:
 - 1. Contractor required to show compliance with code required and Owner required commissioning scope.
 - 2. Contractor to obtain a Fieldwire Pro software license or other software license required by Commissioning Agent for the duration of the project commissioning.
 - 3. **Money will be held until ALL CX activities are addressed and completed.**

3.04 OPERATING INSTRUCTIONS

- A. Prior to final acceptance, instruct an authorized representative of the Owner on the proper operation and maintenance of all mechanical systems, equipment, and controls under this contract. Make available a qualified technician for each component of the installation for this instruction. Give these operation instructions after the operation and maintenance manuals have been furnished to the Owner. Submit written certification, signed by the Contractor, and an authorized representative of the Owner, that this has been completed.

3.05 COORDINATION OF WORK

- A. Each Contractor shall compare his Drawings and Specifications with those of other Trades and report any discrepancies between them to the Architect and obtain from the Architect written instructions to make the necessary changes in any of the affected work. All work shall be installed in cooperation with other Trades installing interrelated work. Before installation, all trades shall make proper provisions to avoid interferences in a manner approved by the Architect.
- B. Each Contractor shall coordinate the location of his systems so that all outside air intakes are located in such a way as to prevent cross-contamination from plumbing vents, flue pipes, exhaust fans, etc. Such a distance shall be not less than 10 feet.

- C. Locations of conduit, ducts, piping, sprinkler heads and equipment shall be adjusted to accommodate the work with interferences anticipated and encountered. Exact routing and location of system shall be determined prior to fabrication or installation. Coordinate routing of major electrical conduits with Electrical Contractor prior to fabrication of ductwork and piping.
- D. Offsets and changes of direction in all conduit, ducts and piping systems shall be made as required to maintain proper headroom and pitch of sloping lines whether or not indicated on the drawings.
- E. Where discrepancies in scope of work as to what Trade provides items, such as starters, disconnects, flow switches and the like exist, such conflicts shall be reported to the Architect prior to signing of the Contract. If such action is not taken, the various Trades shall furnish such items as part of their work for complete and operable systems and equipment, as determined by the Architect.
- F. **The HVAC, Plumbing and Fire Protection Subcontractors shall verify with Electrical Subcontractor the available electrical characteristics for all motors and equipment before ordering and submitting of respective gear. Verify actual connection points prior to installation and roughing-in. Mechanical and Electrical Contractor are responsible for coordination of electrical requirements and final fuse sizes of all A/C equipment. When Mechanical Contractor substitutes equipment that requires additions or upgrades to electrical system, he shall bear all costs arising from such substitutions. Reference "Mechanical/Electrical Coordination Sheet" in specifications.**
- G. The Contractors are to avoid routing conduit through fire rated assemblies where practical. Each trade is responsible for proper coordination of required sleeves or block-outs with rated assembly installers. Each trade is responsible for providing sleeves, as required, for his work. Each trade shall verify acceptable tolerances around penetrating item in fire assembly before beginning fire sealing.
- H. Mechanical Contractor and Controls Contractor shall coordinate all requirements of equipment and controls to insure a fully operational system.
- I. Coordinate all plumbing rough-in through floor(s) with structural concrete TEE's/structural steel. Do not pass through stem of TEE's.

3.06 OPERATION AND MAINTENANCE MANUALS

- A. Provide PDF of information requested, in organized, bookmarked format.
- B. Provide Operation and Maintenance manual for training of Owner's personnel in operation and maintenance of systems and related equipment in the manner described elsewhere in these specifications, in organized PDF format, with bookmarks. In addition, organize manuals and include data and narrative as noted below. Provide PDF copy of O&M for owner records.
- C. Operating Sequence and Procedures:
 - 1. Contents: In each chapter, describe the procedures necessary for personnel to operate the system and equipment covered in that chapter. Also, include a copy of System Balancing Report.
 - 2. Typewritten Operating procedures: Write procedures for start-up, operation, and shutdown.
 - a. Start-up: Give complete step-by-step instructions for energizing equipment, making initial setting and adjustments whenever applicable.

- b. Shutdown Procedure: Include instructions for stopping and securing the equipment after operation. If a particular sequence is required, give step-by-step instruction in that order.
- D. Maintenance Instructions:
 - 1. Provide a schedule of preventive maintenance for each product. Recommend frequency of performance for each preventive maintenance task: i.e., cleaning, inspection, etc.
- E. Manufacturer's Brochures: Include manufacturers' descriptive literature covering all appurtenances used in each system, together with illustrations, exploded views and renewal parts lists. Provide nearest manufacturers' representatives name, address and phone number.
- F. Shop Drawings: Provide a copy of all corrected, approved submittals and shop drawings covering equipment for the project either with the manufacturers' brochures or properly identified in a separate subsection.
- G. Spare Parts Lists: Include a list of all equipment furnished for project, with a tabulation of descriptive data of all the spare parts proposed for each type of equipment or system. Properly identify each part by part number and manufacturer.
- H. All major Owner training sessions to be videotaped in non-pixelated video in Windows file format.

3.07 OPERATION PRIOR TO COMPLETION

- A. When any piece of mechanical or electrical equipment is operable and it is the advantage of the Contractor to operate the equipment, he may do so providing that he properly supervises the operation. **All HVAC equipment shall be shut down when painting, sanding and similar construction operations detrimental to the equipment are being done.** The warranty period shall, however, not commence until such time as the equipment is operated solely for the benefit of the Owner at his request or as listed in 'C'. Contractor shall clean any ductwork and equipment that is dirty due to equipment operation or improper protection.
- B. **Any units that are operated during construction shall have filter media (Fiberbond Dual-Ply DustLok Media) placed over the exterior of return air grilles. Media shall be changed as frequently as required to keep ductwork clean.**
- C. Regardless of whether or not the equipment has been operated, the Contractor shall properly clean the equipment, install clean filter media, properly adjust the equipment and complete all punch list items before final acceptance by the Owner. The day following final acceptance by the Owner will be the start date of the warranty period.

3.08 RECORD FOR OWNER

- A. Each Contractor shall accumulate and bind in an "Operating and Maintenance" manual the following data to be presented to the Owner at the completion of the Project.
 - 1. All warranties and guarantees and manufacturer's instruction on equipment and material covered by the contract.
 - 2. Approved equipment brochures, wiring diagrams and control diagrams.
 - 3. Copies of approved shop diagrams.

4. Operating instructions for heating and cooling and other mechanical systems. Operating instructions shall also include recommended maintenance and seasonal changeover procedures.
5. Repair parts lists of all major items and equipment including name, address and telephone number of local supplier or agent.
6. Valve tag charts and diagrams herein before specified.
7. HVAC balance and test results.
8. HVAC equipment start-up forms that include model and serial numbers of each piece of mechanical equipment installed, by unit mark number. For split units provide this information for all components.
9. "As-Built" Drawings as specified under "Construction Drawings" (these are not to be bound in the O&M Manual).

3.09 SITE OBSERVATION

- A. Periodically, the Engineer will visit the site and review the construction progress. Field Reports will be issued noting any discrepancies or items that do not meet the intent of the contract documents found during said site visit. The contractor must answer each item listed on each field report, item by item. Large projects may break up site walks by area, project must be 75,000 sqft or larger to request multiple site trips for same type of inspection. Minimum sqft size of divided inspection should be 30,000 sqft or larger.
- B. **Contractor Readiness Forms:** Contractors are to complete all Contractor Readiness Forms from Engineer for each phase of inspection prior to calling for any engineering site inspections. Contractor Readiness Form must be acknowledged in writing and pictures when appropriate, some are room by room, some are per each piece of equipment depending on form. These forms must be completed, signed off by installing contractor as complete and General Contractor as verified, and submitted with request for calling for site inspections. If forms are incomplete, missing name of person verifying, missing phone number of person verifying, then site visit will not be scheduled.
- C. **It shall be the duty of the Contractor to personally make a careful inspection of the entire project, assuring himself that the work on the project is ready for final acceptance and all Contractor Readiness Forms and Equipment Start-up form are completed (with no deficiencies), signed and submitted minimum 1 week before calling upon the Owner, Architect or Engineer to make final acceptance of the work. Subsequent trips required because of Contractor's failure to do so, will be made at Contractor's expense. (Minimum trip charge due to failure of final inspection readiness \$2,500.)**
- D. The final acceptance of the work will be made jointly by the Architect and the Owner.
- E. Contractors are to obtain a Fieldwire Pro Software License or other software license required by MEP Engineer for the duration of the project. This software will be used to generate and respond to Field Reports.
 1. Contractors that are required to obtain software:
 - a. Mechanical Contractor
 - b. Plumbing Contractor

- c. Electrical Contractor
- d. Test and Balance Contractor
- e. Controls Contractor
- f. General Contractor

3.10 MECHANICAL/ELECTRICAL

- A. **THIS IS TO BE DONE PRIOR TO SUBMITTING ELECTRICAL GEAR. Contractor to submit Mechanical/Electrical equipment coordination sheet with equipment submittal for actual equipment (MAU's, RTU's, AHU's, CU's, HP's, HRU's, Airhawks, AFU's, HETD's, etc) being installed. Reference chart at end of section. This is for Contractor coordination purposes.**

3.11 START-UP REPORT VERIFICATION – Prior to Final Inspection Request

- A. Controls Contractor, Mechanical Contractor and Test and Balance (T&B) Contractor must provide a signed document stating that all control integration, equipment start-up and complete test and balance (no deficiencies) has been completed prior to final mechanical inspections or initial Commissioning visit. Control integration equipment start-up and T&B reports that include outstanding deficiencies are not considered complete. All final start-up reports are to be submitted to Engineer, prior to final inspection request. All forms must include signature and phone number of person completing. Partial completed form will not be accepted, payment for Equipment Start-Up will be zero dollars until 100% of Start-Up forms are completed, deficiencies corrected and submitted to Engineer.

3.12 CERTIFICATE OF COMPLETION

- A. Submit, at time of request for final inspection, a completed letter in the following format:
1. I, (Name) , of (Firm) , certify that the electrical work is complete in accordance with Contract Plans and Specifications, and authorized change orders (copies attached) and will be ready for final inspection as of (Date). I further certify that the following specification requirements have been fulfilled:
 2. Test and Balance Completed, final report attached with no deficiencies.
 3. Mechanical Equipment Start-up completed, documentation attached.
 4. Factory Equipment Start-up completed, documentation attached.
 5. Controls Start-up completed, documentation attached.
 6. Contractor Readiness Forms Completed documentation attached.
 7. Commissioning Forms, Reports, Functional Test etc completed, documentation attached.
 8. Final Clean up Completed.
 9. Fresh Set of Filters installed.
 10. All Systems are Fully Operational.
 11. Record drawings up-to-date and ready to deliver to engineer.

- Signed: _____

3.13 BIM PROTOCOLS

The following protocols apply to the production, use of, and limits of the electronic model used by, or created by Hendrix Consulting Engineers (HCE) as part of the project Building Information Modeling (BIM) process and specific to the Mechanical, Electrical, Plumbing (MEP) systems or this part of the Project designed by HCE.

The definitions, terms and limits, and descriptions herein shall supersede any contract terms and conditions relating to BIM, or BIM Execution Plan, or similar BIM article(s), when applied to HCE, included as part of the Project.

Purpose of the Model:

The electronic model is an instrument of service, intended for the production of 2-Dimensional (2D) Contract Documents via a 3-Dimensional (3D) design and coordination process. Hendrix Consulting Engineers (HCE) may choose to model those elements determined suitable for 3D coordination. However, the model will not include all elements necessary for complete MEP systems design and installation nor will it include all elements and requirements reflected on the 2D Contract Documents, which include the Project drawings and specifications.

Expectations for Limits of Modeled Elements:

The model will be used for coordination between design team members as outlined in the Level of Development section below. At the onset of the Project, the design team will agree on the limits of modeled elements.

Generally, modeled elements will include the following:

- HVAC: Pipes greater than 3" (nominal size, not including insulation), ductwork modeled at a design level for general design intent, equipment, and diffusers, registers, grilles, and louvers.
- Plumbing: Piping greater than 3' (nominal size, not including Insulation), equipment, fixtures.
- Electrical: Light fixtures, distribution equipment and panels.

The model will generally **not** include the following:

- Flanges, fittings, hangers, pull boxes, seismic restraints, and other assembly data subject to the means and methods of construction.
- Thermostats, sensors, detectors, switches, and other wall/ceiling devices denoted by symbol on the plans.
- Dampers and duct accessories with some exceptions at the discretion of HCE.
- Valves and pipe specialties with some exceptions at the discretion of HCE.
- Specific connections to equipment with some exceptions at the discretion of HCE.
- Exterior pipe and duct Insulation and interior ductwork liner will **not** be modeled.
- Fire Protection systems other than the main piping and components used to develop the performance design.
- Conduit and panels for automated control systems
- Conduit and devices for Fire Alarm systems
- Other "performance design" elements will **not** be modeled.
- Accurate quantities suitable for estimating, construction, or cataloguing.
- Specific manufacturer information other than where HCE, at its sole discretion, chooses to include such information.
- Representation or controlling criteria in regard to the sequencing of construction. Any such information presented by the model is coincidental.
- Fully coordinated systems.

Other stipulations:

- Under no conditions may the model be used for fabrication or quantity take-offs.
- If the model is forwarded to the Contractor and/or subcontractors, the Contractor and subcontractors may only use the model as a reference-only model to understand design intent.

As noted herein, the model is an instrument of service. As such, any Information contained in the model is subordinate to the printed, 2D Contract Documents. In the case of any conflicts or differences, the 2D Contract Documents are the controlling documents.

Level of Development (LOD):

The following LOD descriptions shall apply to the work performed by, and model provided by, Hendrix Consulting Engineers (HCE). These descriptions include the content requirements and associated authorized uses for each progressively detailed LOD. Each subsequent LOD builds on the previous LOD. The model content requirements apply only to those systems, components, and assemblies HCE chooses to include within the model. The authorized uses noted herein constitute the only allowed uses of the model.

LOD 100

Model Content Requirements. Basic spatial requirements and system concepts used to support the development of the architectural model. Systems and components are not modeled for dimensional or location accuracy.

Authorized Uses. The model may be used to generate 2D drawings representing the design concept. The model may be used by the design team for developing concepts and coordination criteria.

Application. An LOD 100 model will apply to Concept Design and Schematic Design phases.

LOD 200

Model Content Requirements. Model elements are modeled as generalized systems, components, or assemblies with approximate quantities, sizes, shapes, and locations and shall not be considered as "dimensionally accurate." Non-geometric information may be attached to Model Elements at the sole discretion of HCE. While modeled elements are intended to support the coordination process, modeled elements shall not be considered coordinated at this LOD.

Authorized Uses. The model may be used to generate 2D drawings representing the status of the design. The model may be used by the design team to coordinate rights-of-way for major system components. The model may be used for clash detection by the design team within the limits of expectations defined herein. HCE will not respond to itemized clash reports at this level as modeled elements are not considered coordinated at this level. Clash detection reports will be used as coordination for CD phase documentation only.

Application An LOD 200 model will apply to the Design Development phase.

LOD 300

Model Content Requirements. Model elements are modeled as generalized systems, components, or assemblies with approximate quantities, sizes, shapes, and locations and shall not be considered as "dimensionally accurate." Non-geometric information may be attached to Model Elements at the sole discretion of HCE. At this LOD and at the sole discretion of HCE, specific model elements accurate in terms of size and shape may be included. These elements may or may not be imported from specific manufacturers in order to define a basis of design. Where equipment elements are shown, HCE makes no representation of the accuracy of the elements since any manufactured equipment or component is subject to continual change and alternate manufacturers are typically permitted. While modeled elements are intended to support the coordination process at a more detailed level, modeled elements shall not be considered completely coordinated at this LOD.

Authorized Uses. The model may be used to generate 2D drawings representing the status of the design. The model may be used by the design team to coordinate rights-of-way for major system components, primary system components, and secondary distribution components. The model may be used for clash detection by the design team within the limits of expectations defined herein.

Application. An LOD 300 model will apply to the Contract Document phase.

LOD 400:

Model Content Requirements. Model elements are modeled as specific systems, components, or assemblies that are accurate in terms of size, shape, location, and quantity with fabrication, assembly, and detailing information. Non-geometric information may be attached to Model Elements. Where possible, elements are modeled from actual manufacturer's data to include information specific to the selected manufacturers.

Authorized Uses. The Contractor may choose to produce an LOD 400 model to generate 2D coordination drawings and/or for detailed, 3D installation coordination among the construction team. During this process the design model, which is not an LOD 400 model, may be used by the construction team as a reference-only document to help clarify the design Intent.

Application. An LOD 400 model will apply to the Shop Drawing and Construction Coordination phases and is the responsibility of the Contractor. The Scope of Work for Hendrix Consulting Engineers (HCE) does not include an LOD 400 model.

LOD 500:

Model Content Requirements. Model elements are modeled as actual constructed (As-built) systems, components, and assemblies accurate in terms of size, shape, location, and quantity. Non-geometric Information including Operation and Maintenance Data and linked submittal data is attached to Model Elements where applicable.

Authorized Uses. The model may be used for maintaining, altering, and adding to the Project, but only to the extent consistent with any license granted in other binding Agreements or Contracts or in a separate licensing agreement.

Application. An LOD 500 model will apply to the As-Built phase and is the responsibility of the Contractor. The Scope of Work for HCE does not include an LOD 500 model.

Clash Detection:

It is expected clash detection will be performed by the design team to aid in design coordination. Due to the limits of available software, elements identified as "clashing" may not actually be in conflict and should not be construed as conflicts or errors on the part of the design team. If clash detection will be utilized, an agreement will be made as to what constitutes a "clash" and when resolution of clashes is required. The model is a design tool rather than an installation tool. Therefore, some clashes are expected and may be left in place where a construction resolution is available.

Insomuch as we do not have complete control over the design, selection of materials, or sequencing of construction for the Project, HCE makes no representation that the model will be "clash-free" or without conflicts requiring resolution by the Contractor during the formal production of Shop Drawings and field Coordination Drawings.

Availability of Model.

The model will be made available subject to the Terms of the Prime Agreement.

Contractor's Role:

The Contractor is solely responsible for the decisions made for their use of the model. The Contractor is ultimately responsible for the complete and coordinated installation of all systems depicted on the Contract Documents, whether or not said systems are completely depicted within the model. The model, as an instrument of service, is not intended to dictate means and methods, scheduling requirements, sequencing, or exact quantities; these requirements are the sole responsibility of the Contractor.

Integrated Project Teams:

When integrated project teams, such as Design/Assist, Design/Build, Lean Design, or CM/GC, are part of the project the terms herein shall still apply. However, the project team may alter certain aspects of these terms to allow shared roles in regard to the development of the model. Any such alterations must be approved by HCE and Shall be implemented without additional liability to HCE.

Ownership of Documents:

The model, and all documents produced by Hendrix Consulting Engineers (HCE) under this agreement shall remain the property of HCE and may not be used by the Client for any other endeavor without the written consent of HCE.



115 East Main Street

COMMISSIONING • FIELD INVESTIGATIONS

Round Rock, Texas 78664

PH: (512) 218-0060

FIRM F-4095

FAX: (512) 218-0077

PRE-CONSTRUCTION INSTRUCTION SHEET

Submittal/RFI Requirements

- A. 'Individual submittals' means separate submittals with unique submittal numbers. One single giant PDF will be rejected.
- B. 2 Submittal CATEGORIES (Reference Specifications)
- a. Not required unless deviating from specification
 - b. PDF allowed.

PDF SUBMITTAL/RFI FILE TITLE REQUIREMENT:

For submittal sections listed below as allowed pdf's the following requirements must be met or the submittal will not get through email security and will be auto-deleted and not checked. Each pdf submittal must be a separate pdf file.

PDF FILE: MUST BE NAMED AS FOLLOWS:

JOB NAME – SUBMITTAL No. XX – SUBMITTAL DESCRIPTION

JOB NAME – RFI No. XX – RFI DESCRIPTION

Example: Texas ISD ES No. 2 – Submittal 8 – Plumbing Fixtures

Example: Texas ISD ES No. 2 – RFI 3 – Library Light Fixture Mounting Height

EMAIL TITLE/SUBJECT REQUIREMENTS:

Emails without Job Name and proper format will not get through email security and will be auto-deleted and not checked.

JOB NAME – SUBMITTAL No. XX – SUBMITTAL DESCRIPTION

JOB NAME – RFI No. XX – RFI DESCRIPTION

- C. If submittals are submitted early relative to construction phasing, submittals may be held, reviewed and returned at the appropriate time for construction phasing, not necessarily 2 weeks. In some cases, if submittals are received vastly out of order of construction, submittal may be rejected.

- D. Time Critical Submittal Coordination Items

Mechanical to provide to General Contractor for Structural Roof Coordination

- a. Mechanical to provide roof opening shop drawing as early as possible for structural coordination. Per specifications.

Mechanical to provide to General and Electrical Contractors for Gear Coordination

- b. Mechanical to complete "MECHANICAL/ELECTRICAL COORDINATION SHEET" prior to electrical gear submittals for coordination with electrical contractor. Per specifications.

- E. **Do not submit non pre-approved substitutions during submittal time. These submittals will be automatically REJECTED. Substitution Pre-approval was at bid time.**
- F. **Review time for multiple resubmittals of non-approved equipment will result in Contractor being billed for review time that is not part of Engineer's Scope. Engineer will bill Contractor at Engineer's Current hourly rates.**
- G. **Email of all Submittals/RFI's must go directly to Architect. Do not Copy Engineer.**
- H. **Engineer is not the Contractors plan reference resource. Do not submit an RFI until drawings and specifications have been reviewed first. If the answer is clearly on the drawings the response will be "The answer is clearly on the drawings, Engineer is not the Contractors plan reference resource."**
- I. **Call before submitting a written RFI.**
- J. **All formal Job emails must come from Architect.**
- K. **Do not email send recurring jobsite meeting requests to Engineer. Engineer does not attend all weekly meetings. Architect will coordinate when Engineer is to be required at job site for specific meetings.**
- L. **All equipment that will be controlled by or monitored by the DDC System must include the information needed by the Controls Contractor to properly integrate the equipment with the Controls System.**
- M. **All equipment submittals to include a detail instruction on what needs to be set up in the field when the equipment is started up and step-by-step instructions on how to complete the set-up. Do no submit generic information that covers multiple types of equipment. The instructions must be specific to the equipment scheduled with all of the accessories and sequences specified.**

Shop Drawings and Cad Files

- A. Contractor Shop Drawings must use Architectural Backgrounds and Architectural RCP's (when available or lighting floorplan) and **Mechanical Contractor Shop Drawings** for coordination purposes. Do not request MEP floorplans, this will be cut and paste into an email for you to read. Engineer cannot send architectural backgrounds.
- B. If no Architectural RCP is available for light locations. Lighting Floorplans will be released.
- C. Mechanical Floorplan will be released to Mechanical Contractor for aid in production of his own shop drawings. HCE mechanical drawings may not be submitted as shop drawings.
- D. Fire Alarm, Sprinkler, Intercom etc. all to use Architectural Backgrounds, must be obtained from Architect.
- E. Schedule and Details sheets will not be released.

MEP/ENERGY CONSULTANTS



SUBSTITUTION REQUEST

FROM: _____ DATE: _____

PROJECT: _____

RE: _____

COMMISSIONING • FIELD INVESTIGATIONS *The following has been submitted for consideration on the aforementioned project:*

Specification Title, Section, Page and Article/Paragraph: _____

Drawings and Details Affected: _____

Proposed Substitution/Description: _____

Installer's Name: _____

Manufacturer's name: _____

Point by Point Comparative Data attached - REQUIRED BY A/E (_____ # of pages including cover)

Why is Substitution Being Submitted?

- Pre-Bid Substitution (Prior Approval): Include detailed analysis comparing proposed substitution against specified product, including redlined Specifications showing differences or deviations.
- Specified product is not available. Explain in detail as attachment.
- Cost Savings to Owner. Indicate comparative cost analysis as attachment.
- Other. Explain.

Effects of Proposed Substitution?

(Attach complete explanations and technical data, including laboratory test, if applicable.) Include complete information changes to Drawings and/or Specification that proposed substitution would require for its proper installation. Fill in blanks below:

- A. Does substitution affect dimensions shown on drawings? No Yes
- B. Will undersigned pay for changes to building design, including engineering and detailing costs caused by requested substitution? No Yes
- C. What affect does substitution have on other trades?

- D. Differences between proposed substitution and specified item?

- E. Indicate how proposed substitution meets LEED requirements. (if applicable)
- F. Manufacturer's guarantees of proposed and specified items are:
 Same Different (explain on attachment)

- The Contractor and Subcontractor certifies:
- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
 - Same warranty will be furnished for proposed substitution as for specified product.
 - Similar maintenance service and source of replacement parts, as applicable is available.
 - Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
 - Proposed substitution does not affect dimensions and functional clearances.
 - Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.

Submitted By: (name, address, telephone and contact person of manufacturer and installer of proposed substitution)

For A/E Use: SR# _____

Accepted Accepted as Noted

Not Accepted Received Too Late

Incomplete Information

No Substitutions Accepted

Reviewed by/date: _____

Comments: _____

Subcontractor's signature and date: _____

Contractor's signature and date: _____

COPY TO:

FILE OWNER CONTRACTOR

ENGINEER _____



115 E. Main Street
Round Rock, Texas 78664
(512)218-0060-office
(512)218-0077-fax



Pre - Wall Cover-Up Contractor Readiness Checklist

THE FOLLOWING ITEMS ARE COMMON ITEMS NOTED FOR THIS INSPECTION AND MUST BE CHECKED IN EVERY ROOM PRIOR TO REQUESTING AN ABOVE CEILING INSPECTION FOR THAT ROOM.

GENERAL ITEMS:

Completed () / Initials

- / _____ ITEM NO.1: WHERE EXTERNAL INSULATION TERMINATES, SEAL INSULATION TO DUCTWORK WITH MASTIC AND 3" GLASS FIBER REINFORCING MESH PER SPECIFICATION SECTION '20 07 00, 3.04, C.'
- / _____ ITEM NO.2: FOR ALL ROOF MOUNTED MECHANICAL EQUIPMENT, ONLY CUT ROOF DECK FOR DUCT DROPS. SPECIFICATION SECTION
- / _____ ITEM NO.3: WHEN REFRIGERANT PIPING IS LOCATED BEHIND WALLS, INSURE REFRIGERANT PIPING DOES NOT COME IN CONTACT WITH STEEL STUDS OR CLAMPS, AND HAS NAIL/SCREW PROTECTION AT STUDS. SPECIFICATION SECTION
- / _____ ITEM NO.4: RAINLEADER PIPE SIZE MAY NOT BE REDUCED IN DIRECTION OF DISCHARGE, MUST REMAIN FULL SIZE INCLUDING DROPS. RAINLEADER PIPING, RAINLEADER BODY AND FLANGES MUST BE INSULATED PERS SPECIFICATION
- / _____ ITEM NO.5: HORIZONTAL MC CABLE IS NOT ALLOWED IN WALL CAVITY. SPECIFICATION SECTION
- / _____ ITEM NO.6: FOR ALL DEVICE ROUGH-IN NEAR DOOR, FOLLOW DETAIL ON ELECTRICAL SHEETS. USE CADDY BRACKETS TO GET MULTIPLE DEVICES IN SINGLE STUD SPACE. ALL SWITCHES, THERMOSTATS, INTERCOM BUTTONS, WALL FIRE ALARM DEVICES INSTALLED BY DOOR PER ROUGH-IN DETAIL DEVICES SHOULD NOT EXTEND OVER 24" FROM DOOR FRAME. NO DEVICES SHOULD BE ROUGHED-IN, THAT WOULD CONFLICT WITH CABINETS OR WHITE BOARDS. ITEMS DEVIATING FROM DETAIL THAT CAUSE OWNER PROBLEMS WILL BE RELOCATED EVEN AFTER SHEETROCK INSTALLED. SPECIFICATION SECTION
- / _____ ITEM NO.7: ALL EXPOSED EXTERIOR CONDUIT FROM GRADE TO PANEL OR 36" AND BELOW, MUST BE RIGID PIPE. CONDUIT NOT FOLLOWING SPECIFICATION WILL HAVE TO BE REMOVED

AND REPLACED, EVEN IF WIRE HAS ALREADY BEEN PULLED. PAY SPECIAL ATTENTION TO EXTERIOR RACK MOUNTED SERVICES. SPECIFICATION SECTION

/ _____ ITEM NO.8: ALL CONDUIT AND J-BOX STRAPS AND SPACING MUST BE PER CODE.

/ _____ ITEM NO.9: TECHNOLOGY AND POWER TO BE WITHIN 6" OF EACH OTHER OR IN SAME STUD SPACE WHEN SHOWN TOGETHER. REFERENCE POWER AND TECHNOLOGY PLANS. REFERENCE BLOCK NOTE ON POWER PLANS. DEVICES INTENDED TO BE LOCATED NEXT TO EACH OTHER THAT ARE NOT IN THE SAME STUD SPACE WILL BE RELOCATED, EVEN AFTER SHEETROCK. SPECIFICATION SECTION

/ _____ ITEM NO.10: CONFIRM TRANSFER DUCTS INSTALLED IN ALL WALLS TO DECK WHEN SHOWN ON PLANS OR REQUIRED FOR RETURN AIR PATH. PROVIDE PLAN HIGHLIGHTING ALL WALLS TO DECK AND INSTALLED TRANSFERS. SPECIFICATION SECTION

/ _____ ITEM NO.11: WHEN CONDUIT PENETRATES FLOOR, HOLES IN SUSPENDED SLABS, HOLES MUST BE SEALED FROM TOP AND BOTTOM PRIOR TO CLOSING UP WALLS. SPECIFICATION SECTION

/ _____ ITEM NO.12: PROVIDE DRAWING SHOWING LOCATION AND SIZE OF ALL WATER HAMMER ARRESTORS INSTALLED. MUST BE INSTALLED AND SIZED PER SPECIFICATION AND MANUFACTURERS INSTALLATION INSTRUCTION. SPECIFICATION SECTION

/ _____ ITEM NO.13: ENSURE GROUNDING/BONDING BUSHINGS ON ALL PANEL CONDUITS AND GROUNDING CONDUITS FROM TRANSFORMERS. SPECIFICATION SECTION

THE CONTRACTOR SHALL RESPOND IN WRITING THAT ALL DEFICIENCIES HAVE BEEN CORRECTED. SEND RESPONSE BACK TO ARCHITECT.

Signature of Person Completing Readiness Checklist. _____ Date _____



Pre - Above Ceiling Contractor Readiness Checklist

THE FOLLOWING ITEMS ARE COMMON ITEMS NOTED FOR THIS INSPECTION AND MUST BE CHECKED IN EVERY ROOM PRIOR TO REQUESTING AN ABOVE CEILING INSPECTION FOR THAT ROOM.

GENERAL ITEMS:

Completed () / Initials

- / _____ ITEM NO.1: CONFIRM ALL RUN OUT TAPS HAVE BALANCING DAMPERS WITH STAND-OFF MOUNTING BRACKETS PER SPECIFICAN AND DETAILS. SPECIFICATION SECTION
- / _____ ITEM NO.2: CONFIRM ALL EXHAUST DUCT WITHIN 36" OF ROOF DECK OR EXTERIOR WALL IS INSULATED PER PLANS AND SPECIFICATIONS. SPECIFICATION SECTION
- / _____ ITEM NO.3: CONFIRM RETURN AIR PATH BACK TO ALL UNITS IS NOT BLOCKED BY WALLS TO DECK. CONFIRM ALL TRANSFERS HAVE BEEN INSTALLED. PROVIDE PLAN HIGHLIGHTING WALLS TO DECK AS INSTALLED AND HIGHLIGHTING AIR TRANSFERS INSTALLED FOR REVIEW. THIS IS FOR REVIEW TO CONFIRM IF ANY ADDITIONAL TRANSFERS ARE REQUIRED OR OPENING ABOVE CEILING NEED TO BE CUT INTO SHEET ROCK ON WALLS TO DECK PRIOR TO CEILING COVER UP. SPECIFICATION SECTION
- / _____ ITEM NO.4: REFRIGERANT PIPING: CONFIRM ALL REFRIGERANT PIPING IS COMPLETELY INSULATED AND INSULATION SEALED, INCLUDING CONTINUOUSLY THROUGH WALLS. ENSURE PIPE SADDLES ARE INSTALLED AT ALL SUPPORTS FOR REFRIGERANT PIPING. SPACING PER SPECIFICATIONS
- / _____ ITEM NO.5: CONFIRM BACK OF ALL SUPPLY GRILLES ARE INSULATED. SPECIFICATION SECTION
- / _____ ITEM NO.6: ALL EXTERIOR LIGHTS SEALED TO BUILDING.
- / _____ ITEM NO.7: CONFIRM ANY DAMAGED INSULATION FOR DUCTWORK, WATER PIPING, REFRIGERANT PIPING IS REPAIRED AND PROPERLY SEALED TO PREVENT CONDENSATION.

SPECIFICATION SECTION

- / _____ ITEM NO.8: CONFIRM ALL PENETRATIONS THROUGH FIRE WALLS HAVE BE CAULKED. SPECIFICATION SECTION
- / _____ ITEM NO.9: CONFIRM ACCESS DOORS ARE PROVIDED FOR ALL FIRE/SMOKE DAMPERS AND OTHER REQUIRED LOCATIONS, PER DETAILS, SPECIFICATIONS FOR ACCESS TO REQUIRED COMPONENTS. ENSURE ACCESS DOORS ARE PROVIDED IN DUCTWORK AS DECRIBED IN RTU AND AHU DETAILS AT FIRST 90° TURN FOR RTU AND BOTH SUPPLY AND RETURN OF AHU. REFERENCE SPECIFICATION FOR PROPER SIZE AND SPACING.
- / _____ ITEM NO.10: CONFIRM ALL MECHANICAL UNITS, WATER HEATERS, PANELBOARDS, TRANSFORMERS ETC.. ARE LABELED WITH ALL REQUIRED INFORMATION AND WITH PROPER MATERIAL PER SPECIFICATION '20 01 00, 3.05, B'.
- / _____ ITEM NO.11: CONFIRM ALL CABLES ARE INDEPENDANTLY SUPPORTED PER SPECIFICATIONS. CONTROLS, FIRE ALARM, LIGHTING CONTROL, POWER, TECHNOLOGY, INTERCOM ETC.. SPECIFICATION SECTION
- / _____ ITEM NO.12: CONFIRM INSULATION IS SEALED AT ALL HANGERS. SPECIFICATION SECTION
- / _____ ITEM NO.13: CONFIRM ISOLATORS ARE INSTALLED AT ALL EQUIPMENT AS REQUIRED BY SPECIFICATION AND DETAILS. SPECIFICATION SECTION
- / _____ ITEM NO.14: FOR ALL EXTERIOR EQUIPMENT: CONFIRM HAIL GUARDS ARE INSTALLED IMMEDIATELY WHEN UNIT IS INSTALLED AT SITE TO PREVENT HAIL DAMAGE FROM OCCURRING. HAIL DAMAGE DURING CONSTRUCTION DUE TO NOT INSTALLING HAIL GUARDS IS CONTRACTORS' RESPONSIBILITY. SPECIFICATION SECTION
- / _____ ITEM NO.15: ROOF MOUNTED CONDENSING UNITS: CONFIRM ALL ROOF MOUNTED CONDENSING UNIT ARE INSTALLED ON THY-CURBS, ALL METAL CROSS SUPPORTS ARE GALVANIZED AND CUT ENDS ARE PAINTED WITH GALVANIZED PAINT. ALL CONDENSING UNITS MUST BE PROPERLY SECURED TO THY-CURB PER DETAIL. NO PENETRATIONS ALLOWED IN TOP OF THY CURB. INSURE ALL SIDE DISCHARGE CONDENSING UNIT ARE AIMED CORRECTLY AND NOT BLOWING INTO INTAKE OF ADJACENT CONDENSING UNIT. INSURE ALL SIDE DISCHARGE CONDENSING UNIT HAVE AIR DIRVERTER INSTALLED CORRECTLY IN THE UP POSITION. SPECIFICATION SECTION
- / _____ ITEM NO.17: EXTERIOR REFRIGERATION PIPING: ENSURE ALL EXTERIOR REFRIGERANT PIPING INSULATION IS WEATHER

PROOFED WITH ALUMINUM WRAP PER SPECIFICATIONS.
SUPPORTED PROPERLY AND INSTALLED IN MANNER THAT
DOES NOT IMPEAD MAINTANANCE ACCESS.
SPECIFICATION SECTION

- / _____ ITEM NO.19: INSULATION THROUGH WALLS: VERIFY ALL DUCTWORK, PIPING, AND REFRIGERATION PIPING INSULATION IS CONTINUOUS THROUGH WALLS. BREAKS IN INSULATION INSIDE WALL WILL CAUSE CONDENSATION AND MOLD
SPECIFICATION SECTION
- / _____ ITEM NO.21: PIPING LABELING: CONFIRM ALL PIPING IS LABELED WITH WATER TYPE AND DIRECTIONAL ARROWS, WITH PROPER COLOR, SIZE, SPACING PER SPECIFICATION SECTION '20 01 00, 3.09, C'.
- / _____ ITEM NO.22: CONFIRM ALL VALVES ARE TAGGED PER SPECIFICATION SECTION '20 01 00, 3.05, A'. PROVIDE MAP OF ALL LOCATION IN PDF FORM TO OWNER.
- / _____ ITEM NO.23: PROVIDE CEILING ACCESS MARKERS FOR ALL MECHANICAL UNITS, VALVES, ETC... PER SPECIFICATION SECTION '20 01 00, 3.05, D'.
- / _____ ITEM NO.25: INSURE ALL REFRIGERANT PIPING, WATER PIPING AND DUCTWORK SUPPORTS ARE PROVIDED PIPE SADDLES UNDER HANGERS AS REQUIRED FOR ALL LOCATIONS. SUPPORT SPACING MUST BE PER SPECIFICAITONS
- / _____ ITEM NO.26: EXTERIOR MEP PENETRATIONS: ALL PENETRATION THROUGH EXTERIOR WALLS/DRAIN PLANES MUST BE SEALED WATERTIGHT PER DETAILS AND SPECIFICATIONS. INCLUDING BUT NOT LIMITED TOO: RAINLEADER, CONDUIT, HOSE BIBBS, REFRIGERANT PIPING, FIRE SPRINKLER TEST PIPE, LIGHT FIXTURES, RECEPTACLES, WATER PIPING PENETRATIONS ETC... SPECIFICATION SECTION
- / _____ ITEM NO.28: PIPING SUPPORTS: ENSURE PROPER PIPING SUPPORTS ARE USED TO SUPPORT DISSIMILAR METALS PER SPECIFICATION SECTION
- / _____ ITEM NO.29: GAS PIPING ON ROOF: ALL BRANCH GAS TAP MUST BE TAPPED OFF TOP OF MAIN GAS LINE. DIRT LEG MUST BE INSTALLED AT ALL UNIT CONNECTIONS MINIMUM 3" ABOVE ROOF. ALL GAS PIPING MUST BE PRIMED AND PAINTED. MUST BE SUPPORTED WITH PPH TYPE ROLLER SUPPORTS WITH PROPER SPACING PER SPECIFICATION SECTION
- / _____ ITEM NO.30: PEX PIPING SUPPORTS (WHEN USED): INSURE CORRECT PEX ISOLATION FITTINGS ARE BEING USED TO SUPPORT PEX PIPING IN WALL. CONFIRM CORRECT CONTINUOUS PEX SADDLE SUPPORT IS BEING USED FOR PEX ABOVE CEILING, TO MAINTAIN FLAME SMOKE RATING.

SPECIFICATION SECTION

- / _____ ITEM NO.33: LABEL ALL J-BOXES WITH CIRCUIT AND PANEL NUMBERS. SPECIFICATION SECTION
- / _____ ITEM NO.34: CONFIRM ALL TRANSFORMER GROUND CONNECTIONS HAVE BEEN INSTALLED. SPECIFICATION SECTION
- / _____ ITEM NO.35: CONFIRM ALL UNUSED OPENINGS IN JUNCTION BOXES ARE PROPERLY SEALED. SPECIFICATION SECTION
- / _____ ITEM NO.36: CONFIRM REMOVAL OF ALL TEMPORARY AND UNUSED WIRING AND LIGHTING WHEN APPROPRIATE. SPECIFICATION SECTION
- / _____ ITEM NO.37: CONFIRM LABELING AND PAINTED RED ALL FIRE ALARM JUNCTION BOXES. SPECIFICATION SECTION
- / _____ ITEM NO.38: CONFIRM ALL J-BOXES ABOVE CEILINGS ARE ACCESSIBLE. SPECIFICATION SECTION
- / _____ ITEM NO.39: CONFIRM ALL FLEX CONDUIT ABOVE CEILING IS INDEPENDENTLY STRAPPED. SPECIFICATION SECTION
- / _____ ITEM NO.40: CONFIRM DUCT DETECTORS ARE INSTALLED WHERE REQUIRED. REFERENCE UNIT SCHEDULE, FIRE ALARM SHOP DRAWINGS AND UNITS OVER 2000 CFM. REFERENCE SPECIFICATION SECTION
- / _____ ITEM NO.41: CONFIRM ALL CEILING MOUNTED EXIT SIGNS ARE SECURED TO STRUCTURE. SPECIFICATION SECTION
- / _____ ITEM NO.42: CONFIRM ALL LIGHT FIXTURES HAVE INDEPENDENT SUPPORTS ON MINIMUM 2 CORNERS AND CONFIRM THEY ARE SECURED TO STRUCTURE. SPECIFICATION SECTION
- / _____ ITEM NO.44: ROOF MOUNTED TRANSFORMERS AND PANELS: INSTALL ON THY-CURBS PER DETAIL. ALL STEEL CROSS SUPPORT TO BE HOT DIP GALVANIZED, CUT ENDS PAINTED WITH GALVANIZING PAINT. PROVIDE FOOTPLATE AND RUBBER ISOLATER PAD UNDER FEET OF TRANSFORMER. PROPERLY SECURE TRANSFORMER AND PANEL TO SUPPORT, DO NOT PENETRATE TOP OF THY CURB. DO NOT LEAVE METAL SHAVINGS CAUSING RUST WHEN CUTS ARE MADE. SPECIFICATION SECTION

THE CONTRACTOR SHALL RESPOND IN WRITING THAT ALL DEFICIENCIES HAVE BEEN CORRECTED. SEND RESPONSE BACK TO ARCHITECT.

Signature of Person Completing Readiness Checklist. _____ Date _____



Pre - Final Punch Inspection Contractor Readiness Checklist

THE FOLLOWING ITEMS ARE REQUIRED TO BE ADDRESSED AND SIGNED OFF IN WRITING BY CONTRACTOR FOR EACH UNIT OR ROOM AS INDICATED BY INDIVIDUAL ITEMS BELOW. THESE ITEMS MUST BE COMPLETED AND SUBMITTED WITH ANY DEFICIENCIES CORRECT PRIOR TO REQUESTING FINAL MEP INSPECTION.

GENERAL ITEMS:

COMPLETED () / INITIALS

- / _____ ITEM NO.1: ALL MECHANICAL UNITS: PROVIDE CONTRACTOR READINESS CHECKLIST (START-UP FORMS),
- MECHANICAL CONTRACTOR - START-UP REPORTS
 - MANUFACTURER START-UP FORM (WHEN REQUIRED)
 - MECHANICAL START-UP FORM
 - CONTROLS START-UP FORM
 - TEST-BALANCE WITH ALL DEFICIENCIES ADDRESSED.
 - COMMISSIONING FOR ALL MECHANICAL UNITS AS LISTED IN SPECIFICATION. SCHEDULE OF VALUE LINE ITEM WILL NOT BE PAID UNTIL ALL FORMS FOR ALL EQUIPMENT HAVE BEEN COMPLETED, SUBMITTED AND REVIEWED. PARTIAL PAYMENT WILL NOT BE PROVIDED. SPECIFICATION SECTION 20 00 00.
- / _____ ITEM NO.2: PROVIDE TEST AND BALANCE REPORT WITH ALL DEFICIENCIES ADDRESSED AND WITH DISCHARGE AIR TEMPS IN COOLING MODE PER SPECIFICATIONS.
- / _____ ITEM NO.3: CONFIRM ALL THERMOSTATS CALIBRATED AND ADJUSTED TO + OR – 1 DEGREE ACCURACY. PROVIDE SIGNED FORM FOR ALL SENSORS.
- / _____ ITEM NO.4: CONFIRM LABELING ALL THERMOSTATS PER SPECIFICATION SECTION '20 01 00, 3.05, C.'.

- / _____ ITEM NO.5: DUCTWORK AND INSIDE OF MECHANICAL UNITS TO BE CLEANED.
- / _____ ITEM NO.6: CLEAN SET OF FILTERS TO BE INSTALLED IN ALL UNITS.
- / _____ ITEM NO.7: CHECK DISCHARGE AIR TEMPERATURE OFF OF ALL COOLING UNITS. (INCLUDE DISCHARGE AIR IN COOLING FOR EACH STAGE OF COOLING, MUST BE 56 DEGREES OR COOLER, REFERENCE START-UP FORMS)
- / _____ ITEM NO.8: CHECK DISCHARGE AIR TEMPERATURE AND HUMIDITY OFF OF ALL MAKEUP/OUTSIDE AIR UNITS. (MUST BE 53 DEGREES OR COOLER OFF COIL)
- / _____ ITEM NO.9: PROVIDE LABEL AND DIRECTIONAL ARROWS ON BOTH SIDES OF LABELS ON ALL PIPING PER SPECIFICATION SECTION '20 01 00, 3.09, C.', INCLUDING ABOVE CEILING AND WATER HEATER ROOMS.
- / _____ ITEM NO.10: TAG ALL VALVES PER SPECIFICATION SECTION '20 01 00, 3.05, A.'
- / _____ ITEM NO.11: PROVIDE CEILING ACCESS MARKERS PER SPECIFICATION SECTION '20 01 00, 3.05, D.'
- / _____ ITEM NO.12: LABEL ALL EQUIPMENT PER SPECIFICATION SECTION '20 01 00, 3.05, B.'
- / _____ ITEM NO.13: SINKS:
- CONFIRM ALL EXPOSED SINK WASTE PIPE HAS 'ADA' PADDING INSTALLED.
 - CONFIRM TMV LOCATED AT EACH SINK REQUIRED ON PLUMBING FIXTURE SCHEDULE.
 - PROVIDE AS BUILT OF WATER HAMMER ARRESTORS SIZE AND LOCATION.
- / _____ ITEM NO.14: LABEL PANELBOARDS PER SPECIFICATION SECTION '26 05 00, 3.09, K. INCLUDE ALL INFORMATION REQUIRED, AND TYPED PANELBOARD SCHEDULES WITH ROOM NAMES.
- / _____ ITEM NO.15: PROVIDE FACTORY START-UP AND PROGRAMMING OF 'NLIGHT' LIGHTING CONTROLS. PROVIDE DOCUMENTATION THAT THIS FACTORY PROGRAMMING HAS OCCURRED.

/ _____ ITEM NO.16: PROVIDE DOCUMENTATION THAT MANUFACTURER ONSITE TESTING HAS BEEN COMPLETED FOR SURGE PROTECTION.

/ _____ ITEM NO.17: PROVIDE DOCUMENTATION FOR TRANSFORMERS THAT MANUFACTURER HAS VERIFIED CONNECTIONS AND TESTED USB PORT FUNCTION.

/ _____ ITEM NO.18: CLEAN ALL CONSTRUCTION DEBRIS FROM INSIDE UNITS AND ON ROOF.

/ _____ ITEM NO.19: VERIFY THAT MECHANICAL CONTROL SYSTEM IS COMPLETE.

- ENSURE THAT ACCESS TO CONTROLS IS CONNECTED AND OPERATIONAL.
- OWNER SCHEDULE HAS BEEN INPUT.
- ALL SEQUENCES OF OPERATION FUNCTION PROPERLY
- ALL CONTROL START-UP FORMS COMPLETED AND SUBMITTED.
- ENGINEER WILL REQUIRE ACCESS TO CONTROL SYSTEM DURING FINAL VISIT. PROVIDE ACCESS CODES AND PASSWORDS TO ENGINEER.

/ _____ ITEM NO.20: ALL MECHANICAL, ELECTRICAL AND PLUMBING EQUIPMENT MUST BE POWERED UP AND OPERATIONAL.

/ _____ ITEM NO.21: PAINT AND PRIME ALL GAS PIPING PER SPECIFICATIONS.

/ _____ ITEM NO.22: ROOF SUPPORTS:

- PROVIDE CARRY TREAD / WALK PAD UNDER ALL ROOF SUPPORTS (GAS PIPING, CONDENSATE DRAINS, ETC.) REFERENCE ROOFING SPECIFICATION FOR ALL REQUIREMENTS.
- SUPPORTS PROVIDED PER SPACING REQUIREMENTS IN SPECIFICATIONS.

/ _____ ITEM NO.23: VERIFY INSTALL AND TEST DRAIN PAN FLOAT SWITCH.

/ _____ ITEM NO.24: DUCT ACCESS DOORS: CONFIRM ACCESS DOORS ARE PROVIDED FOR ALL FIRE/SMOKE DAMPERS AND OTHER REQUIRED LOCATIONS, PER DETAILS, SPECIFICATIONS FOR ACCESS TO REQUIRED COMPONENTS. ENSURE ACCESS DOORS ARE PROVIDED IN DUCTWORK AS DESCRIBED IN RTU AND AHU DETAILS AT FIRST 90° TURN FOR RTU AND BOTH SUPPLY AND RETURN OF AHU. REFERENCE SPECIFICATION FOR PROPER

SIZE AND SPACING.

/ _____ ITEM NO.25: ALL WEATHERPROOF RECEPTACLE COVERS ARE REQUIRED TO BE METAL PER SPECIFICATION. PLASTIC NOT ALLOWED.

/ _____ ITEM NO.26: WATER HEATER INSTALLATION CONTRACTOR READINESS CHECKLIST.

/ _____ ITEM NO.27: ELECTRICAL CERTIFICATE OF COMPLETION PER SPECIFICATIONS, INCLUDING ALL GROUNDING TESTING, MEGGER READINGS REQUIRED BY SPECIFICATIONS.

/ _____ ITEM NO.28: DO NOT CALL FOR FINAL INSPECTION UNTIL ALL UNITS HAVE HAD MECHANICAL START-UP FORMS, TEST AND BALANCE, AND CONTROLS FULLY INTEGRATED AND SUBMITTED TO ENGINEER AND COMMISSIONING AGENT.

/ _____ ITEM NO.29: CONTRACTOR READINESS FORMS COMPLETE FOR EACH PIECE OF EQUIPMENT: (ATTACHED)

- MECHANICAL UNITS – AHU, RTU, MAU

- WATER HEATERS

THE CONTRACTOR SHALL RESPOND IN WRITING THAT ALL DEFICIENCIES HAVE BEEN CORRECTED. SEND RESPONSE BACK TO ARCHITECT.

Signature of Person Completing Readiness Checklist. _____ Date _____



ROOF TOP UNITS (RTU) Contractor Readiness Checklist

Roof Top Unit (RTU)

The installation contractor must check and verify all items listed below, prior to calling for a Final RTU inspection. This check list must be completed for all Roof Top Units as part of Final Inspection Readiness. The person performing the check must provide a signed form for each unit. Provide complete signed and dated for each unit prior to calling for final inspection.

- Unit installation:
 - The manufacturer's service and operating clearances have been provided and if free of conduit, piping, ductwork, etc.
 - Unit is level.
 - Hail Guards installed.
 - Unit Curb and Flashing per job details.
 - Roof deck only cut for duct drops, not entire curb dimension.
 - 2 layers of exterior sheathing installed on roof deck inside of curb for sound attenuation.
 - Permanent Label Installed
 - Door Handles installed.
- Drain pan :
 - The float switch is installed, wired to controls and has been tested.
 - Pan has been cleaned of all construction debris.
- Condensate drain:
 - Material is copper.
 - Installed per details with proper trap depth.
 - All cleanouts are installed for easy maintenance.
 - Unions installed per detail
 - Installed with the proper amount of slope.
 - Terminates at a code approved disposal point.
 - The insulation installed and sealed per detail and specification and does not have gaps.
 - Ensure proper air gap at all condensate disposal points.
- Ductwork Items:
 - Ductwork has been connected to the RTU unit as shown in detail.
 - Ductwork insulation ends have been sealed in return air of the RTU.
 - Internal duct insulation 48" past first 90 bend per detail. (unless owner request external)
 - RA internally lined per detail with sheet metal duct liner stops(unless owner request external)
 - Duct Wrap insulation has been terminated as detailed.
 - Duct insulation is continuous under duct smoke detectors.

- Duct access door on supply air after first 90 per detail.
- Duct access doors on both sides of turning vanes when installed.
- The access door in the return air plenum is installed in an easily accessible location for inspection and cleaning. (Access door not required if duct is open for plenum return)
- If an outside air duct is to be connected to Return Air Duct, it must be downstream from the return air inlet / connection.
- The first supply branch duct tap must be downstream from the duct/smoke detector.
- Duct taps not allowed within 48" past elbow.
- Unit access:
 - Ensure Filter removal access is not blocked.
 - Verify that all access doors can be opened or removed without damaging the insulation vapor barrier, per details, specifications, for all required components including Fire/Smoke dampers.
 - No ductwork, Electrical conduit, Fire Alarm Cable, or Controls Wiring to be in service access area.
 - Disconnect is not installed blocking access door.
 - Maintenance Receptacle operational.
- Gas
 -
- Follow ALL associated details
 - Rooftop Unit Curb/Flashing Detail
 - Deep Seal Trap Detail
 - Duct Drop Detail
 - Typical Gas/Condensate Piping Connection Detail

Signature of Person Completing Readiness Checklist. _____ Date_____



AIR HANDLING UNIT (AHU) Contractor Readiness Checklist

Air Handling Unit (AHU)

The installing contractor must check and verify all items listed below prior to calling for a Final AHU inspection. This check list must be completed for all Air Handling Units as part of Final Inspection Readiness. The person performing the check must provide a signed form for each unit. Provide complete signed and dated for each unit prior to calling for final inspection.

- Unit installation:
 - The manufacturer's service and operating clearances have been provided and if free of conduit, piping, ductwork, etc.
 - Spring isolators have been properly sized and installed per the manufacturer's installation instructions. Specifically, all nuts must be field adjusted for proper travel.
 - The refrigerant piping has been installed in a neat workman like manner and does not interfere with required service and operating clearances.
 - Refrigerant piping supported per refrigerant piping detail.
 - Verify unit is installed with positive slope toward condensate drain.
 - Unistrut supporting unit to be installed per detail (long direction of unit)
 - 2" filter rack installed.
- Condensate drain:
 - Installed per details with proper trap depth.
 - All cleanouts are installed for easy maintenance.
 - Installed with the proper amount of slope.
 - Terminates at a code approved disposal point.
 - The insulation is sealed per specification and does not have gaps.
 - Ensure proper air gap at all condensate disposal points.
- Auxiliary Drain pan :
 - Extends beyond air-handling unit as shown / noted in detail.
 - Has the supports installed inside and underneath the pan as shown in detail. (Long direction of pan)
 - The float switch is installed, wired to controls and has been tested.
 - A drain has been installed in Aux Drain Pan and is capped or piped off to the exterior of the building as shown or note on the drawings.
 - Pan has been cleaned of all construction debris.
 - Neoprene isolation tape has been installed between the pan and supports and between the supports and unit as shown in detail.
- Ductwork Items:
 - Ductwork has been connected to the Air Handling unit as shown in detail.
 - Ductwork has been sealed at the Air Handling unit as shown in detail.
 - Duct Wrap insulation has been terminated at the Air Handling unit as detailed.

- Duct insulation is continuous under duct smoke detectors.
- The access door in the return air plenum is installed in an easily accessible location for inspection and cleaning. (Access door not required if duct is open for plenum return)
- If an outside air duct is to be connected to Return Air Duct, it must be downstream from the return air inlet / connection.
- The first supply branch duct tap must be downstream from the duct/smoke detector.
- Unit access:
 - Verify that all access doors can be opened or removed without damaging the insulation vapor barrier, per details, specifications, for all required components including Fire/Smoke dampers.
 - Supports do not interfere with the removal of the access doors.
 - Ensure Filter removal access is not blocked.
 - Verify that all access doors can be opened or removed without damaging the insulation vapor barrier.
 - No ductwork, Electrical conduit, Fire Alarm Cable, or Controls Wiring to be in service access area.
- Unit Test and Balance completed, and ALL deficiencies resolved and provided to Engineer.
- Equipment Start-up form Completed and provided to Engineer.
- Controls Integrated and verified operational.
- Unit Discharges 58 degrees or cooling in ALL speed of cooling and recorded.

Signature of Person Completing Readiness Checklist. _____ Date _____



WATER HEATER (WH) Contractor Readiness Checklist

Water Heater (WH)

The installing contractor must check and verify all items listed below, prior to calling for a Final WH inspection. This check list must be completed for all water heating units as part of Final Inspection Readiness. The person performing the check must provide a signed form for each unit. Provide complete signed and dated for each unit prior to calling for final inspection.

- Unit installation: (per details on plans)
 - The manufacturer's service and operating clearances have been provided and if free of conduit, piping, ductwork, etc.
 - WH has T&P piped off per code.
 - Unions installed on hot and cold-water connections above WH for future maintenance.
 - Drain pan installed,
 - WH sits on Unistrut to lift up in drain pan.
 - Drain pan drain line installed.
 - Expansion tank installed, wall mounted or suspended. (not on floor)
 - Check valve, balancing valves, ball valves, and strainers all installed per detail.
 - HW, CW, HWR all piped according to detail.
 - Aquastat installed.
 - Vacuum breaker installed.
 - Housekeeping pad installed when required.
 - Perforated straps are not allowed for supporting of piping or equipment.
- Piping:
 - Insulated with PVC jacketing per specifications.
 - Ends of insulation covered with mastic.
 - The insulation is sealed per specification and does not have gaps.
 - All piping labeled, with correct label spacing.
 - All piping to be installed in a manner to make changeout of WH easy.
 - Valve Tags installed
- Gas WH:
 - Gas pipe with sufficient straight piece to allow water heater or boiler to function properly.
 - Dirt leg installed with cap and not touching ground.
 - Combustion Air vent piping installed per manufacturer installation instructions.
 - For intake length including bends
 - For exhaust length including bends
 - Termination location, including distance from obstructions and parapets.
 - Provide Acid Neutralization Trap for all condensing gas water heaters.

Signature of Person Completing Readiness Checklist. _____ Date _____



Outstanding Items Final Punch Inspection Contractor Readiness Checklist

THE FOLLOWING ITEMS ARE REQUIRED TO BE ADDRESSED AND SIGNED OFF IN WRITING BY CONTRACTOR FOR EACH UNIT OR ROOM AS INDICATED BY INDIVIDUAL ITEMS BELOW. THESE ITEMS MUST BE COMPLETED AND SUBMITTED WITH ANY DEFICIENCIES CORRECT PRIOR TO REQUESTING FINAL MEP INSPECTION.

GENERAL ITEMS:

COMPLETED () / INITIALS

- / _____ ITEM NO.1: ALL MECHANICAL UNITS: PROVIDE CONTRACTOR READINESS CHECKLIST (START-UP FORMS),
- MECHANICAL CONTRACTOR - START-UP REPORTS
 - MANUFACTURER START-UP FORM (WHEN REQUIRED)
 - MECHANICAL START-UP FORM
 - CONTROLS START-UP FORM
 - TEST-BALANCE WITH ALL DEFICIENCIES ADDRESSED.
 - COMMISSIONING FOR ALL MECHANICAL UNITS AS LISTED IN SPECIFICATION. SCHEDULE OF VALUE LINE ITEM WILL NOT BE PAID UNTIL ALL FORMS FOR ALL EQUIPMENT HAVE BEEN COMPLETED, SUBMITTED AND REVIEWED. PARTIAL PAYMENT WILL NOT BE PROVIDED. SPECIFICATION SECTION 20 00 00.
- / _____ ITEM NO.2: PROVIDE TEST AND BALANCE REPORT WITH ALL DEFICIENCIES ADDRESSED AND WITH DISCHARGE AIR TEMPS IN COOLING MODE PER SPECIFICATIONS.
- / _____ ITEM NO.3: CONFIRM ACCESS DOORS ARE PROVIDED FOR ALL FIRE/SMOKE DAMPERS AND OTHER REQUIRED LOCATIONS, PER DETAILS, SPECIFICATIONS FOR ACCESS TO REQUIRED COMPONENTS. ENSURE ACCESS DOORS ARE PROVIDED IN DUCTWORK AS DESCRIBED IN RTU AND AHU DETAILS AT FIRST 90° TURN FOR RTU AND BOTH SUPPLY AND RETURN OF AHU. REFERENCE SPECIFICATION FOR PROPER SIZE AND SPACING.

/ _____ ITEM NO.4: CONFIRM ALL THERMOSTATS CALIBRATED AND ADJUSTED TO + OR – 1 DEGREE ACCURACY. PROVIDE SIGNED FORM FOR ALL SENSORS.

/ _____ ITEM NO.5: CHECK DISCHARGE AIR TEMPERATURE OFF OF ALL COOLING UNITS. (INCLUDE DISCHARGE AIR IN COOLING FOR EACH STAGE OF COOLING, MUST BE 56 DEGREES OR COOLER, REFERENCE START-UP FORMS)

/ _____ ITEM NO.6: CHECK DISCHARGE AIR TEMPERATURE AND HUMIDITY OFF OF ALL MAKEUP/OUTSIDE AIR UNITS. (MUST BE 53 DEGREES OR COOLER OFF COIL) WHEN MAU'S ARE PRESENT ON JOB.

/ _____ ITEM NO.7: LIGHTING CONTROL TEST DOCUMENTATION : PROVIDE FACTORY START-UP AND PROGRAMMING OF 'NIGHT' LIGHTING CONTROLS. PROVIDE DOCUMENTATION THAT THIS FACTORY PROGRAMMING HAS OCCURRED.

/ _____ ITEM NO.8: SURGE PROTECTION TEST DOCUMENTATION: PROVIDE DOCUMENTATION THAT MANUFACTURER ONSITE TESTING HAS BEEN COMPLETED FOR SURGE PROTECTION.

/ _____ ITEM NO.9: TRANSFORMER TEST DOCUMENTATION: PROVIDE DOCUMENTATION FOR TRANSFORMERS THAT MANUFACTURER HAS VERIFIED CONNECTIONS AND TESTED USB PORT FUNCTION. WHEN TRANSFORMERS PRESENT ON JOB.

/ _____ ITEM NO.10: VERIFY THAT MECHANICAL CONTROL SYSTEM IS COMPLETE.

- ENSURE THAT ACCESS TO CONTROLS IS CONNECTED AND OPERATIONAL.
- OWNER SCHEDULE HAS BEEN INPUT.
- ALL SEQUENCES OF OPERATION FUNCTION PROPERLY
- ALL CONTROL START-UP FORMS COMPLETED AND SUBMITTED.
- ENGINEER WILL REQUIRE ACCESS TO CONTROL SYSTEM DURING FINAL VISIT. PROVIDE ACCESS CODES AND PASSWORDS TO ENGINEER.

/ _____ ITEM NO.11: ELECTRICAL CERTIFICATE OF COMPLETION PER SPECIFICATIONS, INCLUDING ALL GROUNDING TESTING, MEGGER READINGS REQUIRED BY SPECIFICATIONS.

/_____ ITEM NO.12: CONTRACTOR READINESS FORMS COMPLETE FOR EACH PIECE OF EQUIPMENT: (ATTACHED)

- MECHANICAL UNITS – AHU, RTU, MAU

- WATER HEATERS

/_____ ITEM NO.13: AS-BUILTS PROVIDED.

/_____ ITEM NO.14: O&M'S PROVIDED.

/_____ ITEM NO.14: ALL PREVIOUS ITEMS IN ALL PREVIOUS REPORTS THAT HAVE NOT BEEN FIXED ARE STILL CONSIDERED OUTSTAND AND SHOULD BE FIXED WITH PHOTOGRAPHIC PROOF PROVIDED TO OWNER/ENGINEER/ARCHITECT, PRIOR TO GETTING PAYMENT FOR SUBSTANCIAL COMPLETEION.

THE CONTRACTOR SHALL RESPOND IN WRITING THAT ALL DEFICIENCIES HAVE BEEN CORRECTED. SEND RESPONSE BACK TO ARCHITECT.

Sign before requesting Final Inspection

Signature of Person Completing Readiness Checklist. _____ Date_____

SECTION 20 01 00 - BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section describes specific requirements, products, and methods of execution which are typical throughout ALL work of this project. Additional requirements for the specific systems will be found in the sections specifying those systems and supersede these requirements.
- B. SPECIAL NOTE: All provisions and divisions of these specifications are a part of this section of these specifications. The Contractor shall consult these divisions and provisions in detail for instructions and include all items pertaining to this work. The Contractor shall consult all other divisions of these specifications, determine the extent of impact on the work required to complete the work required by this section of the specifications or portion thereof and related work shown on the drawings.

1.02 JOB CONDITIONS

- A. Obtain approval from Architect prior to cutting any structural elements or furring members.
- B. Structural Interferences: Should structural members prevent the installation of piping, ducting or equipment, notify the Architect before proceeding.
- C. Consider minor changes in position of equipment, piping, or ducting, as part of the contract at no additional cost to the Owner.
- D. Coordinate with Structural and Architectural work to determine acceptable locations for sleeves and supports which are required but may not be specifically shown on the plans. SCHEDULE INSTALLATION OF SLEEVES AND SPECIAL SUPPORTS IN MANNER TIMELY TO THE WORK OF OTHER CRAFT. Anticipate minor offsets necessary for proper coordination with other work and reroute systems appropriately.
- E. It is the Contractor's responsibility to properly use all information found on the Architectural, Structural, Civil and Electrical Drawings where such drawings affect his work.

1.03 DIMENSION AND FIT

- A. Cut materials accurately from measurements taken on the JOB SITE.
- B. Do not spring or bend pipe to fit conditions or make up joints.

1.04 INTERFERENCES

- A. Interferences between piping and other trades shall be handled by giving precedence to pipelines requiring grade for proper operation. Where space requirements conflict, the following order of precedence shall generally be observed. Failure to follow this precedence resulting in spacial conflicts are the Contractor's responsibility to remove and put back per plans in the order of precedence listed.
 - 1. Building Lines
 - 2. Structural Members

3. Soil and Drain Piping
4. Vent Piping
5. Refrigerant Piping
6. Supply, Return, O/A Ductwork
7. Exhaust Ductwork
8. Chilled and Hot Water Piping
9. Domestic Hot and Cold-Water Piping
10. Natural Gas Piping
11. Electrical Conduit
12. Fire Protection Piping

1.05 SERVICEABILITY OF PRODUCTS

- A. Furnish all products to provide the proper orientation of serviceable components to access space provided.
- B. Coordinate installation of piping, ductwork, equipment, coils, system components, and other products to allow proper service of all items requiring periodic maintenance or replacement.
- C. **Replace or relocate all products incorrectly ordered or installed to provide proper serviceability.**

1.06 ACCESSIBILITY OF PRODUCTS

- A. Arrange all work to provide permanent, convenient, and safe access to all serviceable and/or operable products. Layout work to optimize net usable access space within confines of space available. Advise Architect, in a timely manner, of areas where proper access cannot be maintained. Furnish layout drawings to verify this claim, if requested.
- B. Provide access doors in ceilings, walls, floors, etc., for access to traps, valves, dampers, automatic devices, and all serviceable or operable equipment in concealed spaces. Location of panels shall be submitted for approval in sufficient time to be installed in the normal course of work.

1.07 ROUTING

- A. Route all pipelines and ductwork parallel with building lines, and as high as possible, except where under ground or shown otherwise on the plan.
- B. Route piping and ducts to clear all doors, windows and other openings, and to avoid all other pipes and ducts, light fixtures, and similar products.
- C. Conceal all pipes and ducts where routed through finished areas, unless authorized by Architect or otherwise indicated on plans.

PART 2 - PRODUCTS

2.01 MATERIAL PRODUCTS

- A. Provide all products new, unused, and undamaged, of standard manufacture, and of latest design and best quality. **ALL ADHESIVES, SEALANTS AND COATINGS MUST MEET OR EXCEED GREEN BUILDING PROGRAM SCAQMD RULE 1168 AND 1113. ALL PAINTS MUST MEET VOC LIMIT OF GREEN SEAL ENVIRONMENTAL STANDARD GS-11. ALL INSULATION IS TO BE FREE OF UREA-FORMALDEHYDE AND/OR BE GREENGUARD CERTIFIED.**
- B. When a manufacturer's name appears in these specifications or schedule, it is not to be construed that the manufacturer's material does not have to meet the full requirements of the specifications or that his standard catalogue item will be acceptable.
- C. All equipment installed on this project shall have local representation, local factory authorized service and local stock of repair parts.
- D. All materials exposed within a plenum shall be noncombustible or shall have a flame spread index of not more than 25, and a smoke developed index of not more than 50, when tested in accordance with ASTM E 84.

2.02 Where more than one type of material (i.e., cast iron or PVC) is specified, the Contractor may choose one type; however, he must state which type of material he proposes to use in his submittal. **ONLY ONE TYPE OF MATERIAL MAY BE USED IN A SPECIFIC PIPING SYSTEM, UNLESS SPECIFICALLY NOTED OTHERWISE. (I.E. WHEN DIFFERENT SIZES OF THE SAME TYPE SYSTEM REQUIRE DIFFERENT MATERIALS PER SPECIFICATIONS.)**

2.03 PIPE AND FITTINGS

- A. Steel Pipe: **All steel piping and fittings are to be domestically manufactured (USA).**
 - 1. **PROVIDE DOCUMENTATION IN SUBMITTAL STATING LOCATION OF MANUFACTURING.**
 - 2. Threaded: Schedule 40, ASTM A53 grade B or ASTM A120, American Standard pipe thread. Pipe 2" and under to be made up with threaded fittings.
 - 3. Welded: Schedule 40 black, ASTM A53 grade B or ASTM A120, ANSI B16 butt weld fittings of type and wall thickness to suit pipe. Weld-O-Lets and Thread-O-Lets may be used on pipe 2-1/2" and larger where branch is a minimum of two pipe sizes smaller than main. Pipe 2-1/2" and over to be made up with welded fittings. Pipe 2" and under to be made up with threaded fittings.
 - 4. Grooved Pipe: Schedule 40 ASTM A120 or ASTM A53 grade. Standard cut or rolled groove to coupling manufacturer's specifications. Do not use in systems exceeding 200° F. operating temperature.
 - a. Couplings: Standard weight with gasket selected by manufacturer for service intended.
 - b. Fittings: Full flow malleable iron, ductile iron or steel.
 - c. Submit calculations of expansion allowance of joints and obtain approval prior to eliminating any special expansion compensators, swing joints, flexible connections, or vibration isolators.

- d. Manufacturers: Victaulic, Gruvlok or Apollo.
 5. Press fit: Use Viega Mega Press or equal by Apollo.
- B. Copper pipe:
1. Type "K" or "L" hard drawn copper with wrought copper fittings with openings machined to accurate capillary fit for the pipe. Pipe to conform to Standard Specifications for copper water tube. Type 'M' may only be used for A/C condensate drain lines.
 2. Use "lead free" (0.00% lead content) solder for all domestic water piping. Submittal on the product to be used must include this information. Lead free solder to conform to ASTM B 32 and flux to conform to ASTM B 813. Soldered joints must be done in accordance with ASTM B 828. Lead free shall mean a chemical composition equal to or less than 0.2 percent lead.
 3. Press fit joints using Viega, Apollo or equal press fit fittings.
 4. Solder joints using 50/50 lead tin solder for systems operating below 180° F.
 5. Solder joints using 430 silver solder for systems operating at 180° F. or above.
- C. Domestic Copper Pipe (2" and larger): (Contractor Option)
1. Copper tubing systems from two inches (2") through six inches (6") shall be installed using mechanical pipe couplings of a bolted type with a central cavity design pressure-responsive gasket along with grooved end copper fittings.
 2. All copper tubing shall be prepared in accordance with the manufacturer's published specifications.
 3. Couplings - Coupling for copper shall consist of cast ductile iron housing, a synthetic rubber gasket of a central cavity pressure-responsive design, with nuts and bolts to secure unit together.
 - a. Housings - Shall be cast of ductile iron conforming to ASTM A-536 (Grade 65-45-12) with a copper alkyd enamel paint coating.
 - b. Gasket - Gaskets shall be molded of synthetic rubber in a central cavity, pressure-responsive configuration conforming to the copper tube size (CTS) outside diameter and coupling housing, of elastomers having properties as designated in ASTM D-2000.
 - c. Water Service - Gaskets supplied for water services from -30° F to +230° F shall be a Grade "E" EPDM compound, with copper color code, molded of materials conforming to ASTM D-2000, designation 2CA615A15B44F17Z, recommended for hot water service within the specified temperature range.
 4. Flanged Connections: Shall be engaging directly into roll grooved copper tube and fittings and bolting directly to ANSI Class 125 cast iron and Class 150 steel flanged components; installer to supply standard flange bolts. Flange casting shall be as in 3, a. above with a corresponding gasket as in 3, b.
 5. Fittings - Fittings shall be full flow copper fittings with grooves designed to accept grooved end couplings.

- a. Standard fittings shall be two-inch (2") through four-inch (4") copper per ASTM B-75 alloy C12200; five-inch (5") through six-inch (6") bronze sand castings per ASTM B-584-87 copper alloy CDA 844 (81-3-7-9).
6. Butterfly Valves – Lug style, grooved end butterfly valves are to be rated for bi-directional dead-end service to the full working pressure of the valve with the down stream flange removed.
 - a. 2 ½-6" valves shall have either lever lock handles or gear operators. Valves in 2 ½" or 3" sizes may have two-position handle as per service requirements and manufacturer's recommendations.
 - 1) Valve housing shall be bronze per CDA-836 (85-5-5-5).
 - 2) Disc shall be aluminum bronze or ductile iron.
 - 3) Operator bracket shall be steel-black enamel coated.
 - 4) Operator - Two (2) position detent or manual lever lock shall be steel-black enamel coated.
 - 5) Seat to be molded to the body of the valve for bi-directional dead-end service
7. Tube Preparation: Copper tube shall be ASTM B-88 (drawn tubing) and prepared in accordance with the latest published manufacturer's specifications, as applicable. Pressure ratings and end loads for roll grooved copper tubing are based upon test on copper tube prepared in accordance with manufacturer's specifications using manufacturer's approved rolled grooving tool for grooving copper tube.
8. Assembly: Couplings, fittings, adapters and tubing shall be assembled in accordance with the latest published instructions from the manufacturer for the particular product installed.
9. Reference hanger spacing in specification. In addition, use the following recommendations for support installation:
 - a. Copper tubing joined with grooved type couplings requires support to carry the weight of tubing and equipment. The support or hanging method must be such as to eliminate undue stresses on joints, tubing and other components.
 - b. The support system for mechanical grooved type tubing couplings must consider some of the special requirements of these couplings.
- D. Compressed Air Piping:
 1. Piping to be Type K hard drawn copper pipe.
 2. Use capped tees at each joint facing up to allow for future connections. All connections to be made with tees facing up.
 3. Slope all piping to drain. Provide drain leg at each low point with ball valve at bottom of drain leg for draining system. Drain leg to be approximately 7'-6" A.F.F. (verify in field).
 4. Install Metal-Flex flexible connector near compressor outlet equal to Amber/Booth type SS-PM.

2.04 VALVES

- A. Select valves of the best quality and type suited for the specific service and piping system used. Minimum working pressure rating 125 psig steam or 150 psig W.O.G. All valves on insulated lines to have extended handles to allow operation without disturbing insulation seal.
- B. Manufacturer: Nibco, KITZ, Jenkins, Milwaukee, Stockham, Apollo or other recognized manufacturer of equal reliability.
- C. Gate Valves, 2½" and Larger: Iron body, bronze trim, rising stem, flanged.
- D. Globe Valve 2" and Smaller: Teflon disc, bronze body, bronze trim.
- E. Ball Valves 3" and Smaller: Brass or bronze body, virgin TFE seat rings, blow-out proof stem, reinforced thrust washer, ¼ turn full open/full close, FULL PORT, CSA-ULFM approval.
- F. Globe Valve 2½" and Larger: Iron body, bronze trim, Buna-N disc, flanged, bronze disc hot water, Buna-N disc cold water.
- G. Swing Check Valves 2" and Smaller: Bronze body, horizontal swing, Y-pattern, renewable disc.
- H. Swing Check Valves 2½" and Larger: Iron body, horizontal swing, bolted bonnet, renewable seat and disc, flanged, non-slam type.
- I. **Butterfly Valves: Reference Section 2.03, C. above.**
- J. Drain Valves: Hose end gate valve or gate valves with hose connection. Do not use sillcocks in lieu of drain valves.
- K. Valves Specified Elsewhere: Provide special valves such as motor operated valves, relief valves, temperature regulating valves, etc., as specified under the individual system or as indicated on the drawings.
- L. **USE FULL PORT BALL VALVES RATED FOR SERVICE INTENDED FOR ALL ISOLATION VALVES THREE INCHES (3") AND SMALLER.**

2.05 BALANCING VALVES

- A. Provide balancing valves for all cooling and heating flows and at all pump discharge lines. Provide balancing valves for all potable hot/tempered water recirculation systems and at TMV's as required by manufacturer's written instructions.
- B. Valves sized for maximum 1-pound pressure drop at design flow with valve wide open. Submit schedule of balancing valves indicating sizes, flow ranges and pressure drop curves.
- C. Valves, rated at not less than 150 psi, furnished with three self-lubricating bronze or teflon-coated stainless-steel bushings with shaft seals at each bushing; seals to be hard back resilient type and shall be field replaceable; discs shall be bronze, aluminum-bronze, or semi-steel with welded nickel edge.
- D. Valves 4" and smaller insulated with removable foam polyurethane Dry Cap. Series 400.
- E. Valve 2½" through 6" shall be lever operated. Butterfly valves, lug body indicating locking type with adjustable memory stop, may be used at Contractor's option at each location where gate valves or globe valve is indicated on water line 2½" and larger.

- F. On valves 2" and smaller, use Flow Set balancing valves system consisting of: 300 lb. rate flow measuring bronze body ball valve with integral venturi and temperature and pressure taps; flow setting 300 lb. butterfly valve assembly with stainless steel disc and Viton seats dual-core temperature/pressure test port and external lockable memory stop. Furnish valves with insulation sleeve for ease of access to temperature/pressure ports and to allow adjustments of valve handles without removing insulation. Manufacturer: FlowSet by Olympic Valve, Inc. At the Contractor's option, use Presso B-Plus balancing valves with extension handle and extension P/T plugs.
- G. Manufacturers: DeZurik, Olympic Valve, Inc., Jenkins, Nibco, B & G, Hammond, Presso, Apollo or approved equal.

2.06 UNIONS

- A. Provide unions adjacent to all tanks and equipment and where required for disconnect and maintenance of equipment.
- B. Union for Steel Pipe: Ground joint malleable iron.
- C. Union for Copper Pipe: All brass.
- D. Union Between Dissimilar Metals: Dielectric Union designed and advertised to be unaffected by heat, cold or fluid in pipe. EPCO or approved equal.

2.07 MISCELLANEOUS

- A. Escutcheons: Nickel or chrome plate with screws or springs for holding plate in position.
- B. Automatic Air Vents: Hoffman #79, Marsh or equal.
- C. Gaskets: Gaskets 1/16-inch thick for all pipe sizes 10 inches and smaller, and 1/8-inch thick for all pipe sizes 12 inches and larger. Gaskets to be ring type between raised face flanges and full-face type between flat face flanges with punched bolt holes and pipe opening. Gasket material shall be suitable for the service intended and shall be installed as recommended by the manufacturer. Manufacturer: Crane, John-Manville, or equal.
- D. Strainers: Cast iron or bronze body basket or wye type strainers provided with ½" valved drain and a ¼" air vent cock, unless the strainer design is devoid of air pockets. Strainers shall have removable cylindrical or conical screens of nickel, copper, or brass and suitable flanges or tappings to connect with the piping they serve. Strainers 2½" and larger shall be provided with flanged covers. The free area of each screen shall not be less than three (3) times the area of the strainer inlet and shall be suitable for the service intended. For chilled and hot water loop systems provide Metraflex LPD-MAG y-strainer with magnet and blow down valve. Manufacturers: Metraflex, Crane, McAlear, Sarco or Armstrong.

2.08 MECHANICAL SUPPORTING DEVICES

- A. General:
 - 1. Securely fasten all mechanical work to the structure to prevent hazard to human life and limb, and to prevent damage to products of construction under all conditions of operation.
- B. Pipe Supports:
 - 1. Single Pipes:

- a. Support all horizontal runs of steel, copper pipe under 2" and all cast-iron soil pipe on suitable hangers spaced not more than 5 feet on centers. Support all steel, and copper piping 2" and larger not more than 10 feet on centers. Support all PVC piping not more than 4 feet on center. Support piping in a manner to prevent binding, undue swing, and the transmission of vibration to the structure.
 - b. Support single pipes from clevis hangers equal to Anvil fig. 260. Install hangers for insulated piping outside the insulation using high density section of insulation and sheet metal shield or saddle. Provide copper plated hangers in contact with copper pipe.
- 2. Trapeze Hangers: Where pipes are clustered, parallel, and in same plane, they may be supported by trapeze hangers. Provide rods and angle-irons sized to suit load imposed. Minimum channel length to be six inches (6"); maximum rod spacing to be twenty-four inches (24") on center. Piping to be securely attached to trapeze hangers. Provide sheetmetal shield or saddle for all insulated piping running horizontally.
 - 3. Piping on Walls: Secure with hook-plates, clips or fabricated steel brackets.
 - 4. Supports from Steel Beams and Similar Construction: Use appropriate beam clamps.
 - 5. Provide inserts for poured concrete and expansion bolts for pre-cast slabs.
 - 6. Guide and anchor piping where necessary to control expansion and contraction. Provide supports and hangers with non-corrosive and rust-resistant finish. Galvanize or plate hanger rods after threading. Hangers other than those specified not permitted. **USE ONLY GALVANIZED HANGERS AND HANGER RODS FOR ALL PIPING IN CRAWL SPACE.**
 - 7. Provide inserts for poured concrete and expansion bolts for pre-cast slabs. Use HiltiDrop-in Anchor or Kwik Bolt II Stud Anchor System. Verify allowable place of anchors with Structural Engineer.
 - 8. Provide pipe supports according to the following schedule:

PIPE SIZE - INCHES	ROD SIZE – INCHES
½" through 2"	3/8"
2½" through 3"	1/2"
4" through 6"	5/8"
8" through 12"	3/4"
 - 9. Manufacturers: Anvil International, C&P, Fee and Mason, Elcen or SuperStrut.
- C. Support all piping on roof with pipe stands/roller equal to MIRO Industries Model 4-RAH-PC or Portable Pipe Hangers, Inc., Type PP10 with roller for piping 2-1/2" and smaller. For piping over 2-1/2", up to and including 8", use MIRO Industries Model 6-RAH-PC or Portable Pipe Hangers, Inc. (PPH) Type PS-1-2. All pipe stands to sit on walk board (coordinate type and methods of support with Roofing Contractor). Walk board to be a minimum of 3" larger on each side than support. Provide minimum pipe height above roof deck as required by jurisdiction having authority (at least 6"). Provide supports for piping under 2" at six feet on center. Provide supports for piping 2" and over at eight feet on center. **PIPE PROP will not be acceptable.**

- D. Ductwork Support: Refer to Section 23 30 00-Air Distribution.
- E. Inserts: Provide all inserts required for installation of horizontal piping. In poured concrete provide wrought steel or malleable iron and adjustable type. Where expansion bolts are necessary to secure piping or equipment, use malleable iron type with expansion case, to be inserted by drilling concrete. Power driven inserts not permitted for supporting piping to ceiling.
- F. Miscellaneous Iron and Steel:
 - 1. Provide all steel supports and hangers to support all equipment or materials unless noted otherwise.
 - 2. All work shall be cut, assembled, welded and finished by skilled mechanics. Welds shall be ground smooth. Stands, brackets and framework shall be properly sized and rigidly constructed in a manner to withstand anticipated loads.
 - 3. Measurements shall be taken on the job and worked out to suit adjoining and connecting work. All work shall be performed by experienced metal-working mechanics. Members shall be straight and true and accurately fitted.
 - 4. Welded joints shall be ground smooth where exposed. Drilling, cutting and fitting shall be done as required to properly install the work and accommodate the work of other Trades.
 - 5. Members shall be generally welded, except that bolting may be used for field assembly where welding would be impractical. Welders shall be skilled and certified.
 - 6. All shop fabricated iron and steel work shall be cleaned and dried and given two (2) coats of weatherproof primer paint on all surfaces and in all openings and crevices.

2.09 ACCESS DOORS

- A. Doors shall be Karp, Inland Steel Products, Milcor, Miami or Walsh-Hannon, constructed of steel with primer coat of rust inhibitive paint, and continuous piano hinge. Doors shall be key operated with flush operated cylinders, keyed alike. Key lock system shall be coordinated with the Owner and shall be approved by the Architect. Provide six (6) keys of type used for access panels for Owner's use. Obtain receipt of key delivery and submit to Architect for record.
 - 1. Suspended Lath and Plaster Ceilings - Style: "M" with 16-gauge frame, 14-gauge panel.
 - 2. Masonry Non-Rated Walls - Style: "M" with 16-gauge frame, 14-gauge panel.
 - 3. Masonry Fire Rated Walls - Fire rated with UL, ½ hour "B" rating, 16-gauge frame, 20-gauge sandwich type insulated panel.
 - 4. For access doors larger than 16" in either direction, provide two (2) locksets.

PART 3 - EXECUTION

3.01 EQUIPMENT MOUNTING

- A. Provide equipment concrete pads, treated support runners, roof curb supports, mounting accessories, supports, hanger expansion joints, adapters and any other appurtenances to adapt fixtures and equipment supplied to the conditions of use.

- B. Provide vibration eliminators as specified (if not specified elsewhere use vibration eliminators recommended by equipment manufacturer) at all pieces of equipment subject to vibration. (Exception; curb mounted equipment does not require vibration isolator rails except when specifically scheduled).
- C. Independently support piping and ductwork at equipment so that no weight is supported by the equipment.
- D. Securely fasten fixtures and equipment to the building structure in accordance with manufacturer's recommendation.
- E. Provide steel base plates for floor mounted fixtures and equipment to distribute the weight so that the floor load is not more than 100 lbs. psf, unless special structural reinforcement is submitted for approval.
- F. At wall attached fixtures and equipment weighing less than 50 pounds, provide backing plates of at least 1/8 x 10-inch sheet metal or 2 x 10-inch fire retardant treated wood securely built into the structural walls. Submit attachment details of heavier equipment for approval.
- G. Electrical conduit shall not be hung from equipment or plumbing piping.
- H. When project is in a wind zone that would require equipment on roof or ground to be secured by additional means required by building code for Wind, Tornado, Hurricane maps, secure per manufacture installation details and if addition direction is required, then coordinate with structural engineer for additional details and methods.

3.02 SLEEVES

- A. Provide sleeves as required where pipes pass through walls, floors, or ceilings. Make sleeves as follows:
 - 1. In non-fire rated bearing walls, foundations, masonry or concrete walls and floors, use schedule 40 black steel pipe.
 - 2. In non-rated construction, use minimum 20-gauge galvanized sheetmetal.
 - 3. In fire rated walls, floors and assemblies, install sleeves as required by UL System Number.
- B. In non-fire rated areas install sleeves flush with surfaces. In mechanical rooms or any wet floor where seepage may occur, install sleeve 1 inch above floor and caulk. Caulk both sides of penetration using UL listed one-part firestop synthetic elastomer sealant, flexible at normal working temperatures, having smoke developed 50, fuel contributed 50, and flame spread 25 rating. Install thickness per manufacturer's recommendation. Manufacturer: Dow Corning FireStop 2000 Sealant, Flame Stop V, 3M: CP-25.
- C. Waterproof all piping and sleeves through building exterior skin, including walls, roofs and interior floor penetrations to prevent leakage. Coordinate with the Architect on caulk material to use at exterior.
- D. Size sleeves for cold piping to allow for continuous insulation through sleeve.

3.03 SEALING AND FIREPROOFING

A. SEALING OF PENETRATIONS THROUGH RATED WALLS, FLOORS, CEILING AND ROOF ASSEMBLIES SHALL BE INSTALLED PER UL "FIRE RESISTANCE DIRECTORY." UL SYSTEM NUMBERS INDICATED ARE FOR A PARTICULAR LISTED INSTALLATION AND ARE FOR GENERAL INFORMATION AND INTENT. OTHER LISTED UL SYSTEM DESIGNS MAY BE USED. IN ALL CASES, SUBMIT MATERIALS, UL SYSTEM DESIGN NUMBERS AND UL DETAILS TO BE USED THROUGHOUT THE PROJECT AND IDENTIFY WHICH DETAIL IS TO BE USED FOR EACH SPECIFIC CONDITION. POST REVIEWED DETAIL AT JOB SITE FOR REFERENCE.

1. Only materials tested in the specific UL System Number may be used.
 - a. Wrap Strip (UL System No. WL 5001): Nominal 1/4" thick by 2" wide intumescent elastomeric material. Manufacturer: 3M Type FS-195.
 - 1) Use one (1) wrap strip for up to one-inch (1") thickness insulation.
 - 2) Use two (2) wrap strips for 1-1/2" inch and larger thickness insulation.
 - b. Caulk Manufacturer:
 - 1) 3M Type CP-25 WB+ for all assemblies requiring 3M caulk.
 - 2) For WL3045 and 3046 use Hilti FS611A Sealant.
 - c. Steel Sleeve (Stud Wall) (UL System 1003): Cylindrical sleeve shall be fabricated from minimum 0.019" thick (no. 28 gauge) galvanized sheet steel and having a minimum 2" lap along the longitudinal seam. Length of steel sleeve to be equal to thickness of wall plus 1" such that, when installed, the ends of the sleeve will project approximately 1/2" beyond the surface of the wall on both sides of the wall assembly. The diameter of the openings cut on each side of the wall assembly (concentric with pipe) to be 2 to 2-1/2" larger than the outside diameter of pipe, such that when the steel sleeve is installed, a 1 to 1-1/4" annular space will be present between the steel sleeve and the pipe around the entire circumference of the pipe. Install sleeve by coiling the sheet steel to a diameter smaller than the through opening, inserting the coil through the openings and releasing the coil to let it uncoil against the circular cutouts in the gypsum wallboard layers.
 - d. Steel Sleeve (Concrete or Block Wall): For cables, provide sleeve cast in floor/wall or mortared into CMU wall; optional sleeve for UL System No. CAJ1175.
 - e. Forming Material: Minimum one-inch (1") thickness mineral-wool batt insulation material. Tightly pack into sleeve with minimum 1/2" recess on ends. Manufacturer: Thermafiber Safing Insulation.
2. Wire/Cables:
 - a. For Gypsum Frame Wall (Single Cable): Fireproof per UL System No. WL3001. Opening for cable to be hole-sawed through gypsum wall board layers. Diameter of opening to be 3/8" to 5/8" inch larger than outside diameter of cable. Cable to be rigidly supported on both sides of wall assembly. Caulk to fill annular space throughout thickness of gypsum wall board layers and apply 1/4" bead of caulk to perimeter of cable at its egress from wall (both sides).

- b. For Gypsum Frame Wall (Multiple Cables): Use UL System No. WL3021, WL3045, WL3046 or equivalent to maintain rating of wall.
 - c. For Concrete Walls/Floors or CMU Walls (Single or Multiple Cables): Fireproof per UL System No. CAJ3030. Cables to be a minimum ten percent (10%), maximum thirty-three percent (33%) of cross-sectional area of opening. Recess minimum one-inch (1") thickness of mineral wool material into opening around cables. Caulk openings around cable to minimum depth of one inch (1"). Optional sleeve may be used per UL detail requirements.
- 3. Firestop system shall be installed at top surface of floor and symmetrically on both sides of wall assemblies.
 - 4. Materials used in firestop systems shall be installed in accordance with the manufacturer's instructions, provided with materials for specific UL System Number.
 - 5. Reference Architectural for the exact location of all rated walls, floors, ceilings and ceiling/roof assemblies.
- B. Manufacturers: 3M, Metacaulk, Hilti, BioFireshield, STI or equal.
 - C. In non-rated walls identified for sound insulation, provide 1/2" space between pipe and sleeve packed with multiple layers of forming material. Allow 5/8" minimum space on each side and caulk with acoustical sealant.
 - D. **Final condition to prevent passage of fire, smoke, noxious gas and water.**
 - E. For non-rated mechanical/electrical room walls: Seal all piping and ductwork passing through walls, floors and ceilings with 3M caulk, Type CP-25+.
 - F. Submit UL numbers and details for type of penetrations and materials to be used. All penetrations in fire rated walls, floors and ceilings must be installed per a UL listed detail specified for the application.
 - G. **Seal both sides of all floor penetrations into crawl space on both sides to prevent air and water migration.**

3.04 WATERPROOFING AND COUNTERFLASHING

- A. Provide and install all counterflashing of all conduit, pipe or duct and equipment which penetrates roofs, walls and other weather barrier surfaces. **Metal Roofing Contractor shall provide and install all curbs and counter flashing for all metal roof penetrations. Verify detail with Architect before installation.**
- B. All work shall be performed in a workmanlike manner to assure weatherproof installation. Any leaks developed shall be repaired at contractor's expense, to Architect's satisfaction.
- C. Conduits, pipes or ducts passing through slabs shall have the sleeve extended above floors to retain any water and the space between the conduit, pipe or duct and sleeve caulked with lead wool. The top shall be sealed with lead and the bottom shall be sealed with monolastic caulking compound.
- D. All waterproofing, flashing and counterflashing shall be provided and installed by the Roofing Contractor and shall be compatible with roofing system so as not to void any roof warranties. Confirm installation with Architect.

- E. Slope all ducts to wall louvers to drain toward louvers. Provide continuous sleeve thru wall and seal all joints.
- F. **All piping and conduit penetrations through exterior walls shall be sealed on both side of drain plane and at exterior finished wall surface to prevent moisture intrusion.**

3.05 LABELING AND TAGGING

- A. Tag all valves with minimum 1/16" thick heat resistant laminated dark plastic labels engraved with readily legible white lettering 1/4" high indicating fluid in pipe and a "V" (valve) number (e.g. V-22). Securely fasten to the valve stem or bonnet with beaded chain. Provide an aluminum valve chart and frame with glass cover for typewritten valve chart. Install where directed. Coordinate valve numbers with mechanical contractor to avoid duplication. Refer to Section 20 00 00, and Manuals.
- B. Label all equipment with minimum 1/16" thick heat resistant laminated plastic labels having engraved lettering 1/2" high and fastened in place with rivets, screws or adhesive backing. Example "WH-1, AHU-1, etc." If items are not specifically listed on the schedules, consult the Architect concerning designation to use. Refer to Section 20 00 00. Label all equipment served by emergency electrical panels with red labels.
- C. Label all thermostats/sensors with minimum 1/16" thick heat resistant laminated plastic labels having engraved lettering 1/4" high and fastened in place with rivets, screws or adhesive backing. Label is to correspond to rooftop and/or air-handling units.
- D. Provide access panel markers (minimum 1/16" thick laminated plastic type with engraved lettering) to indicate ceiling tile to be used for access for all A/C equipment, terminal units and plumbing shut-off valves. Use light green for plumbing and light blue for A/C equipment. Label to be attached to ceiling grid with rivets, screws or adhesive backing. Example, "AHU-3A" access. Plastic Label shall not be larger than the surface it is affixed to. IE. Shall not overhang grid or flange.
- E. Manufacturer: Seton Pipe Marking Products, MSI (Marketing Services, Inc.) or equal.

3.06 TYPICAL PIPING

- A. Provide insulating couplings or unions to prevent electrolysis between dissimilar metals when use of dissimilar metals cannot be avoided in one system.
- B. Close all openings in pipes with appropriate caps, plugs, or covers during storage and progress of the work to preclude introduction of contaminants.
- C. Arrange systems and locate valves so that either entire system or separate sections thereof may be drained for service. All service valves located no more than 24 inches above the ceiling and normally accessible from an 8-foot ladder.
- D. Provide valves and unions adjacent to all tanks, batteries of plumbing fixtures and equipment, for disconnect purposes. **Install all valves with stems vertical wherever possible, and in no case with stems below the horizontal.**
- E. Ream ends of all pipe to full diameter.
- F. Provide pipe anchors, swing joints, and expansion compensators as required to control the expansion of pipelines.
- G. Reduce pipe sizes using reducing tees or reducing fittings. Bushings not permitted except on tanks and similar equipment.

- H. Provide escutcheons on all pipes passing through walls, floors, and ceilings in finished areas where piping is in counters, closets or cabinets, and subject to view when doors are open. Cover the pipe sleeve and secure plate in position.
- I. Install hangers at each change in direction, and within 2 feet at each elbow or tee. This requirement is mandatory.
- J. Pipe hooks, wire, chains or perforated metal shall not be used for pipe supports.
- K. Insulate hangers for copper pipe from piping with at least two layers of 12 mil Polyken 826 corrosion control tape.
- L. Install piping not to interfere with removal of equipment, ducts and devices or block access to door or access openings.
- M. Piping serving plumbing fixtures and equipment shall be securely supported near the point where pipes penetrate the finished wall.
- N. Test all piping in accordance with accepted trade standards if not specified elsewhere.

3.07 THREADED PIPE

- A. Cut all threads true and of depth to make up properly without leaks.
- B. Make connections to show at least two threads and not more than four threads when tight.
- C. Make up joints with Teflon tape only as recommended by tape manufacturer, or as specified in specific piping sections.

3.08 AUTOMATIC (MANUAL) AIR VENTS

- A. Install at highest point of chilled and hot water system, at chilled and hot water coils and at points necessary to relieve air in piping. Provide shut-off valve to facilitate maintenance of air vent.
- B. Route 1/4" copper line from discharge of air vent to floor drain in mechanical room. Slope to drain.

3.09 PAINTING AND CODING

- A. Ductwork and Piping: Prime and paint all exposed angle braces, hanger rods or straps, damper rods, and quadrants with one coat aluminum paint after removing scale and rust. Prime and paint ductwork and piping exposed in finished rooms to match room finish. Prime and paint all black iron piping located outdoors or otherwise exposed to weather. Coordinate painting and color with Architectural paint specified elsewhere. All painting done by persons regularly employed at and skilled in that trade.
- B. Grilles, Registers, Etc.: Furnish all grilles, registers, etc., other than extruded aluminum or plastic, with prime coat paint by manufacturer. Furnish all ceiling grilles, registers and diffusers with factory applied baked enamel to match ceiling tile. Paint all ductwork and/or conduit visible through registers, grilles and other openings with one coat of flat black paint to a point four feet (4') from opening on straight duct or around bend, whichever applies.

C. Pipe Coding and Labeling:

1. Identify piping with pressure-sensitive coded pipe marker. Secure both ends of marker with pressure sensitive tape with flow arrows (on both sides of label) on roll to indicate flow direction.
 - a. Max 20' spacing.
 - b. Within 24" of disappearing or emerging from wall.
 - c. Taps to fixtures with 36" or more before entering wall.
 - d. Taps to equipment – within 24" of equipment connection. (when not concealed in a wall.
 - e. Color code pipe markers and arrows indicating the liquid and/or use of the pipe. IE: markers for HW and CW must be different color.
2. Code piping to the following schedule: (SUBMIT ALTERNATE CODING)

Cold Water	CW
Hot Water	HW
Hot Water Circulating	HWC
Gas	FUEL GAS
Sprinkler	SPKR
Condensate	Condensate
3. Manufacturers: Seton Pipe Marking Products, MSI or equal.

END OF SECTION

SECTION 20 02 00 - SCHEDULE OF VALUES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The Contractor shall breakdown the final Schedule of Values to be used for Pay Application into the following minimum categories.
- B. **All categories shall have appropriate material and labor breakdown.**
- C. SPECIAL NOTE: All provisions and divisions of these specifications are a part of this section of these specifications. The Contractor shall consult these divisions and provisions in detail for instructions and include all items pertaining to this work. The Contractor shall consult all other divisions of these specifications, determine the extent of impact on the work required to complete the work required by this section of the specifications or portion thereof and related work shown on the drawings.
- D. All Equipment Start-Up line items submitted for payment will be zero dollars until 100% of Start-Up forms are completed, deficiencies corrected and submitted to Engineer in writing. Partial payment of these items will not be done. All forms must include signature and phone number of person completing. Partially completed form will not be accepted. This applies to Mechanical, Controls, Test and Balance, Contractor Equipment Start-Up line items. Reference below and Equipment Start-up specification for additional information.

1.02 SCHEDULE OF VALUES

- A. Site Wastewater
- B. Site Water
- C. Plumbing Rough-in Below Slab
- D. Plumbing Rough-in Above Slab
- E. Rainleader Piping System Below Slab
- F. Rainleader Piping System Above Slab
- G. Insulation (water and rainleader piping)
- H. Acid Waste/Vent Piping
- I. Plumbing Fixture/Trim (this is to include setting fixtures and water and wastewater final connections)
- J. Water Heater
- K. Mechanical A/C Equipment
- L. Ductwork
- M. Ductwork Insulation
- N. Diffusers and Trim Out

- O. Exhaust Systems
 - P. Gas Piping
 - Q. Condensate Piping
 - R. Balancing and Testing
 - S. Testing/Sterilization (Water/Wastewater)
 - T. Controls
 - U. Controls Graphics – Submittal (\$10,000 minimum)
 - V. Completed Controls Equipment Start-Up forms (minimum \$500/unit) (\$50,000 minimum)
 - W. Owner Training Controls
 - X. Labeling Equipment
 - Y. Record Drawings/O & M Manuals - (\$10,000 minimum)
 - Z. Completed Mechanical Equipment Start-Up Form (minimum \$750/unit) (\$50,000 minimum)
 - AA. Completed Test and Balance (minimum 10% of Test and Balance contract)
 - BB. Commissioning Reports Completed (minimum \$1,500/unit) (\$100,000 minimum)
 - CC. Mandatory Pre-Construction Meeting (DDC Contractor, Mechanical Contractor, Test and Balance Representative) (\$25,000 per Contractor)
- 1.03 Schedule of Values must be approved before Monthly Pay Application will be approved.

END OF SECTION

SECTION 20 07 00 - INSULATION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Description:
1. This section describes specific requirements, products and methods of execution which relate to the insulation of ducts, pipes and other surfaces of the mechanical installation.
 2. Insulation is provided for the following purposes:
 - a. Energy conservation
 - b. Control of condensation
 - c. Safety of operating personnel
- B. SPECIAL NOTE: All provisions and divisions of these specifications are a part of this section of these specifications. The Contractor shall consult these divisions and provisions in detail for instructions and include all items pertaining to this work. The Contractor shall consult all other divisions of these specifications, determine the extent of impact on the work required to complete the work required by this section of the specifications or portion thereof and related work shown on the drawings.
- C. Acoustical Lining Insulation Summary
1. The work covered by this specification consists of furnishing all labor, equipment, materials and accessories, and performing all operations required, for correct fabrication and installation of air duct systems of sheet metal lined with fibrous glass duct liner, in accordance with applicable project drawings and specifications, subject to terms and conditions of the contract:
 2. All air duct systems operating at internal air velocities not exceeding rated duct liner limitations as listed below and internal air temperature not exceeding 250°F (121°C).
 3. Duct liner products shall conform to the requirements of ASTM C1071. **ALL INSULATION IS TO BE FREE OF UREA-FORMALDEHYDE AND/OR BE GREENGUARD CERTIFIED.**
 4. The manufacturer's product identification shall appear on the air stream surface.
 5. Duct liner adhesive shall conform to the requirements of ASTM C 916. **ALL ADHESIVES, SEALANTS AND COATINGS MUST MEET OR EXCEED GREEN BUILDING PROGRAM SCAQMD RULE 1168 AND 1113.**
 6. The finished duct system shall meet the requirements of NFPA 90A and 90B.
 7. Duct dimensions shown on the plans are finished inside dimensions.
 8. Fabrication and installation shall conform to the requirements of the latest edition of the North American Insulation Manufacturers Association's *Fibrous Glass Duct Liner Standard* (hereinafter referred to as NAIMA FGDLs) or the Sheet Metal and Air

Conditioning Contractors National Association *HVAC Duct Construction Standards - Metal and Flexible* (hereinafter referred to as SMACNA HVAC DCS) or the manufacturer's recommendations.

D. References

1. American Society of Testing and Materials (ASTM)
 - a. ASTM C1071
 - b. ASTM C916
 - c. ASTM G21
 - d. ASTM G22
 - e. ASTM C423
 - f. ASTM C518
2. National Fire Protection Association (NFPA)
 - a. NFPA 90A
 - b. NFPA 90B
 - c. NFPA 259
3. Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
 - a. HVAC Duct Construction Standards Metal and Flexible (HVAC DCS)
4. North American Insulation Manufacturers Association (NAIMA)
 - a. Fibrous Glass Duct Liner Standard (FGDLS)
5. International Nonwovens & Disposables Association (INDA)
 - a. IST 80.6

E. Delivery, Storage and Handling

1. Deliver all materials and/or fabricated insulated duct sections and fittings to the job site and store in a safe, dry place.
2. Protect materials from dust, dirt, moisture, and physical abuse before and during installation, startup and commissioning. Wet or contaminated duct liner shall be replaced.

PART 2 - PRODUCTS

2.01 FIRE RATING OF MATERIALS

- A. Provide all insulation products used above ground in buildings with burning characteristics not to exceed the following ratings according to NFPA 255-1972 "Method of Test of Surface Burning Characteristics of Building Materials": Flame Spread 25, Fuel Contributed 50, Smoke Developed 50.
- B. Insulation specified for use underground and above ground away from the building, might have other burning characteristics. Use such products only where specifically required.

2.02 INSULATION

- A. TYPE "A": Pre-molded Fiberglass Piping Insulation:
 - 1. Jacketed Type:
 - a. Thermal conductivity $K = 0.24$ at 100° F. mean temperature.
 - b. Factory applied kraft-reinforced vapor barrier flame retardant all service jacket and tape, with permeability rating - 0.02 perms. All service jacket with polymer film exterior surface that is smooth, durable, cleanable, wrinkle resistant, resists water staining and that does not support mold or mildew growth.
 - c. Provide insulation sections with self-sealing pressure sensitive adhesive on both overlap seam and mating jacket surface.
 - d. Fitting insulated with pre-cut insulation inserts covered with PVC fitting cover properly vapor sealed.
 - e. Manufacturer: Owens-Corning Fiberglass SSL II with ASJ Max or equal product by: Knauf or Manville with WMP-ASJ jacket.
 - 2. Secondary Jacket (This goes on over properly sealed standard WMP-ASJ jacketing) All piping run within spaces such as Water Heater Rooms, Mechanical Rooms, Janitor Closets and unconditioned spaces such as Crawl Spaces or ventilated attic spaces):
 - a. PVC jacket Shall be used in all mechanical/boiler rooms for all insulated piping to within two inches (2") of interior wall surface of mechanical/boiler rooms. This includes all satellite mechanical rooms containing air handlers.
 - b. One (1) piece "hinged" construction.
 - c. **Entire piping system in mechanical rooms is to be covered with high-impact, UV-resistant polyvinyl chloride jacketing with gloss white finish with 25/50 rating.** Properly seal all joints. Follow manufacturers written installation instructions.
 - d. ALL Fittings to be insulated with pre-cut insulation inserts and are to be covered with PVC fitting cover.
 - e. All piping in Unconditioned spaces other than mechanical rooms are to be wrapped with mold resistant Polyguard ZERO-PERM vapor barrier membrane. Properly seal all joints. Follow manufacturers written installation instructions.

B. TYPE "B": Cellular Piping Insulation:

1. Thermal conductivity $K = .27 @ 75^{\circ} \text{F}$. mean temperature.
2. Elastomeric thermal insulation with permeability rating of .17 perms and Microban antimicrobial protection against mold growth.
3. Temperature range from -40°F to 220°F .
4. Insulation to meet 25/50 requirements for use in return air plenums.
5. Wall thickness as listed in Part 3 of this Section for size and use of piping.
6. Install without slit when possible. All slits in insulation to be smooth. Insulation installed with jagged edges will be removed and replaced at no cost to Owner.
7. **ALL INSULATION IS TO BE FREE OF UREA-FORMALDEHYDE AND/OR BE GREENGUARD CERTIFIED.**
8. When used on VRF and minisplit heat pumps use Armacell Armaflex UT pipe insulation.
9. Manufacturers: Armacell Armaflex Pipe Insulation or equal by Aerocell or K-Flex. All insulation located outside must be Armacell Armaflex Shield with UV-Resistant durable protective jacket. If piping is serving VRF or minisplit heat pump provide Armaflex UT with additional coating of WB UV protection.

C. TYPE "C": Blanket Type Duct Wrap Fiberglass Insulation:

1. **The Contractor may use a 3/4, 1 or 1-1/2-pound density product with a minimum installed R-value of 6.0 if ductwork is within building insulation envelope or minimum R-value of 8.0 if installed outside of building insulation envelope.** Density, thickness and installed R-value to be clearly indicated on submittal.
2. Fiberglass duct wrap insulation is to have a factory FSK or FRK facing which acts as the vapor barrier. Maximum permeability rating is 0.02 perms.
3. Use only labeled Type UL181AP Aluminum Foil Tape a minimum of 3" wide and 7.4 mils thick "Venture Tape #1525CW" or "Shurtape #AF-982"). Maintain a complete vapor barrier throughout all ductwork insulation applications. Use spreader to completely seal tape to all joints or tears in vapor barrier, surface must be clean prior to installation.
4. Certainteed SoftTouch Duct Wrap with FSK facing or equal. **ALL INSULATION IS TO BE FREE OF UREA-FORMALDEHYDE AND/OR BE GREENGUARD CERTIFIED.**
5. Manufacturers: Knauf, Schuller/Manville, Certainteed or Owens-Corning (**NO MANSON**) .

D. TYPE "F": FIRE RESISTIVE DUCT WRAP

1. Work of this section includes labor, material and equipment to provide 2-hour, fire resistive rated grease or air duct enclosure as a shaft alternative and a method for providing zero-inch clearances around commercial kitchen grease duct exhaust systems to combustible materials.
2. Lightweight flexible refractory ceramic fiber blanket encapsulated with aluminum foil scrim. Nominal 1 1/2" thick, 9 PCF.

3. UL Classified, double layer, fireproof, flexible, 2 hr. rated enclosed assembly with offset seams and stainless-steel bands as required to meet 2-hour requirement.
4. Zero clearance to combustibles.
5. Use in combination with 3M Fire Barrier, 2000+ silicone sealant.
6. 3M, UL system V-17. Install as listed.
7. Manufacturer: 3M FireMaster Fast Wrap or equal by Unifrax Fyrewrap or Pyroscrat as approved by local AHJ.

2.01 SOUND CONTROL

A. Lined Duct: (As noted only)

1. **Provide acoustically lined duct to attenuate and control the transfer of airborne sound and as duct insulation only when specifically indicated.**
2. Lining: Flexible fiberglass blanket type mat faced insulation with durable surface coating, bonded with thermosetting resin. Maximum flame spread index; 25. Maximum smoke developed index; 50. **Lining to have anti-microbial coating.** Minimum R-value of 6.0 for one and one-half (1-1/2") thickness. Installed R-value to be a minimum of 6.0. **1.5" thick, R-6 lining equal to CertainTeed ToughGard R-EP or ToughGard2 Textile Duct Liner.** R-8 for ducts located outside the building insulation envelope. **ALL INSULATION IS TO BE FREE OF UREA-FORMALDEHYDE AND/OR BE GREENGUARD CERTIFIED.**
3. Air Friction Correction Factor 1.12 at 500 fpm or less.
4. Minimum sound absorption co-efficients as follows:

Thickness	Frequency					
	125	250	500	1000	2000	4000
1-1/2"	.17	.53	.87	.99	1.00	.95
5. All duct dimensions shown on drawings are net clear inside dimensions with duct liner. Install liner in compliance with requirements of NFPA 90A.
6. Manufacturers: Shuller, CertainTeed, Knauf or Owens-Corning.
7. All duct liner to be provided with tough abrasion resistant interior air side finish and antimicrobial coating.

2.02 INSULATED FITTING COVERS AND JACKETING

- A. High-impact, 25/50 rated UV-resistant polyvinyl chloride jacketing with gloss white finish.
- B. Pre-cut curled jacketing, 30 mil. thickness. Sized to snugly fit pipe diameter with thickness of insulation specified.
- C. Joints and seams sealed with Perma-Weld Adhesive to form a complete vapor barrier for chilled water and domestic cold-water systems. Use tack and tape for heating water and domestic hot water systems. Installation of adhesives, tacks and tape shall be per manufacturer's recommendations. Submit installation instructions with submittal of materials.

- D. Fitting Covers: Covers shall be pre-formed for fitting shape.
- E. Manufacturer: Manville Zeston 2000 or Proto.

2.03 CANVAS JACKETING

- A. Insulating Lagging Canvas: 8oz./sq. ft. minimum, 28 threads per inch minimum, Osnaberg or equal.
- B. Lagging Adhesive: Plastic synthetic resin emulsion adhesive; watertight, mildew resistant, fire retardant; Miracle LA69, Borden Aerosol or equal. **ALL ADHESIVES, SEALANTS AND COATINGS MUST MEET OR EXCEED GREEN BUILDING PROGRAM SCAQMD RULE 1168 AND 1113.**

2.04 METAL OR VINALUM JACKETING

- A. Material shall be minimum .016" thick aluminum jacket or vinalum .020" thick aluminum faced PVC jacket with integral factory applied vapor barrier.
- B. Elbows, fitting and valves shall be metal preformed fitting covers (no gores acceptable). Valves made from .020 metal. All valves ends and where insulation reduces, shall have Pittsburgh seams.
 - 1. All straight-line metal to be Z-locked jacket held in place with 3/4" wide aluminum bands at nine inches (9") on center with wing seals.
- C. All joints and seams shall be watertight with Childers CP-76 OR Foster 95-44.
- D. Manufacturer: "Strap-On" Childer Cawed Systems or equal.

2.05 COATINGS

- A. All coating to bear the UL label. **ALL ADHESIVES, SEALANTS AND COATINGS MUST MEET OR EXCEED GREEN BUILDING PROGRAM SCAQMD RULE 1168 AND 1113.**
- B. On cold or dual service lines, use vapor barrier type coatings.

2.06 METAL SHIELDS (SADDLES)

- A. Metal Shields curved to fit up to midpoint of the insulated pipe.
- B. Metal shields shall be 16 gauge, twelve inches (12") long for pipes up to two inches (2"), 14 gauge, eighteen inches (18") long for piping 2-1/2" to 4", twenty four inches (24") long for piping 5" to 6", 14 gauge, thirty inches (30") long for piping over 6".
- C. Provide rigid insulation for entire length of saddle plus 4" (2" at each end) to properly support piping. All piping support to be on exterior of insulation.

2.07 PRE-INSULATED PIPES

- A. Pre-insulated with minimum 60 mil. PVC jacket manufactured by Southwest Insul-Pipe.
- B. Insulation shall be foam-in-place polyurethane minimum two inches (2") thick.
- C. All fittings, joints, and valves shall be reformed half section type with insulation.

- D. Piping to be heat traced.
- E. Use waterproof cawed material for all fittings and joints.
- F. Mastics shall be outdoor type.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION AND WORKING CONDITIONS

- A. Apply all insulation, fitting covers, mastics and sealants per manufacturer's recommendations.
- B. Do not apply insulation materials until all surfaces to be covered are clean and dry and all foreign materials such as rust, dirt, etc., are removed.
- C. Keep insulation clean and dry during installation and during the application of any finish.
- D. Do not install the insulation on pipe fittings, and pipe joints until the piping is tested and approved.
- E. Do not apply under conditions of excessive humidity or at temperatures below 50° F or above 100° F.

3.02 TECHNIQUE FOR APPLICATION TO PIPES

- A. Close longitudinal joints of pipe insulation firmly and butt insulation sections firmly together.
- B. Neatly and smoothly adhere all laps and butt strips. Adhere three inch (3") wide self-sealing butt joint strips over end joints.
- C. Replace all insulation having loose joints or laps. Sloppy work will not be acceptable and such work shall be removed and re-applied.
- D. Provide ½" over the thickness of insulation specified at all insulated piping in outside walls.
- E. Where insulation with a vapor barrier terminates, it shall be sealed with "Ductmate Protack". Ends shall not be left raw.
- F. On water piping use sheet metal shields outside the insulation at hanger locations. In addition, provide:
 - 1. A molded vegetable cork or foam glass insert not less than twelve inches (12") long of same thickness and contour as insulation between support shield and piping and under the finish jacket.
 - 2. Heavy density insulation minimum six (6) pounds per cubic foot under entire length of metal shield.
- G. Where piping and fittings are installed out of doors, provide vapor barrier jacket, cover with metal or vinalum jacket with seams located on bottom side of horizontal piping.

3.03 TECHNIQUE FOR APPLICATION TO PIPE FITTINGS, UNIONS AND VALVES

- A. On insulated piping with vapor barrier, insulate fittings, unions, valves and flanges including Victaulic and Gustin-Bacon to the same thickness as the pipe insulation.

- B. Any of the following methods of insulation is acceptable:
1. PVC Snap Form Fitting Covers: Wrap all valves and fittings with precut fiberglass insulation wraparound inserts. Brush vapor barrier mastic on adjoining section of pipe insulation and on overlapping edges of jacket and throat seam before applying preformed fitting. Secure cover with stainless steel tacks. Tape joints with pressure sensitive vapor barrier tape.
 2. Blanket Wrap: Wrap the fitting with compressed glass fiber blanket. Wire the blanket securely in place, then cover with a smooth layer of insulating/finishing cement. Cover with glass mesh tape, adhering it with an adhesive coating.
 3. Fabricated Segments: Cut mitered segments from pipe insulation that has the same wall thickness as adjacent pipe insulation, to form a cover which will fit snugly around the fitting. Wire the segments firmly in place and seal the joints with insulating/finishing cement. Apply adhesive coating and wrap with glass mesh tape, then apply another layer of the same coating over the whole assembly.
 4. Cement: Apply insulating finishing cement, molding it to the contour of the fitting. When area is large, apply an under layer of cement, wrap this with glass mesh tape, then apply an outer layer of cement. If the insulation is not concealed, the exposed surface of insulating/ finishing cement is to have a final glass mesh tape wrap embedded in adhesive.
- C. In each of the listed methods, to protect the insulation against contact damage, apply an adhesive coating when the cement is completely dry and hard, then wrap with glass mesh tape. Apply another coating of adhesive over the whole assembly.

3.04 TECHNIQUE FOR APPLICATION TO DUCTWORK

- A. Impaling Over Pins: Install all insulation with edges tightly butted. Impale insulation on pins welded to the duct and secure with speed clips. Trim off pins close to speed clip. Space pins as required to hold insulation firmly against duct surface, but not less than one pin per square foot. Seal all joints and speed clips with glass fabric set in adhesive. Provide metal angle at corners to protect edges of insulation.
- B. Other Method of Securement: If the welded pin method is impossible, secure the insulation to the duct with "Ductmate Protack" or Childers CP-127 or Foster 85-60 adhesive. Cover the entire surface of the metal with adhesive when applying to the underside of horizontal ducts. Application to top and sides may be in strips with a minimum of 50% coverage. Additionally, secure insulation with No. 16 galvanized wire on not more than twelve-inch (12") centers. Provide metal angle at corners to protect edges of insulation. Seal joints as above. **ALL ADHESIVES, SEALANTS AND COATINGS MUST MEET OR EXCEED GREEN BUILDING PROGRAM SCAQMD RULE 1168 AND 1113.**
- C. Where external insulations terminate, seal insulation to ductwork with Childers CP-35 or Foster 30-65 with 3" glass fiber reinforcing mesh.
- D. Impale rigid insulation board over pins. Provide two layers of glass cloth and four layers of weatherproof vapor barrier adhesive coating. Install .040 thick lock-formable aluminum jacket over sealed insulation. All joints are to be 1" standing seams. The top of the aluminum jacket is to slope a minimum of 1" in 12" to sides to prevent collection of water. Install tapered insulation under sloped top for support of aluminum jacket. Provide a minimum of 1" flange out at connection point to mechanical equipment and building to ensure that water does not get under jacket. Provide counterflashing that is appropriate for building material type. Coordinate with Architect to ensure a watertight connection to building.

3.05 EXAMINATION (LINED DUCTWORK)

- A. Verify that the duct liner products are installed in accordance with project drawings, duct liner operating performance parameters and limitations, and provisions of NAIMA FGDLS or SMACNA HVAC DCS or manufacturer's recommendations.

3.06 INSTALLATION (LINED DUCTWORK)

- A. As noted only, Auditorium, Music Practice Room, Band Hall, Air Transfers, Areas specifically noted on plans.
- B. All portions of duct designated to receive duct liner shall be completely covered with duct liner. All joints shall be neatly butted and there shall be no interruptions or gaps. Duct liner shall be installed with the Printed air stream surface treatment exposed to the air stream.
- C. Duct liner shall be adhered to the sheet metal with 90% (minimum) coverage of adhesive complying with the requirements of ASTM C 916. **ALL ADHESIVES, SEALANTS AND COATINGS MUST MEET OR EXCEED GREEN BUILDING PROGRAM SCAQMD RULE 1168 AND 1113.**
- D. All transverse edges that are not to receive sheet metal nosing shall be coated. Longitudinal joints shall occur at the corners of ducts. If duct size and standard duct liner product dimensions make exposed longitudinal joints necessary, such joints shall be coated with adhesive designated for duct liner application and which meets the requirements of ASTM C 916. Such joints shall be additionally secured with mechanical fasteners in accordance with NAIMA FGDLS, or SMACNA HVAC DCS as if they were transverse joints.
- E. Duct liner shall be additionally secured with mechanical fasteners complying with the requirements NAIMA FGDLS or SMACNA HVAC DCS and of the correct type for the duct liner being installed. Fasteners may be either weld-secured or impact-driven and shall be installed perpendicular to the duct surface. Mechanical fasteners shall not compress the insulation more than 1/8" (3 mm) based on nominal insulation thickness. Fastener spacing with respect to interior duct dimensions shall be in accordance with NAIMA FGDLS or SMACNA HVAC DCS. Fastener heads or washers shall have a minimum area of 0.75 in² (484 mm²), with beveled or cupped edges to prevent their cutting into the duct liner.
- F. Where air velocities exceed 4000 fpm (20.3 m/sec), metal nosing (either channel or "zee" profile) shall be installed on upstream edges of liner duct sections.
- G. Metal nosing shall be securely installed over transverse liner edges facing the airstream at fan discharge and at any point where lined duct is preceded by unlined duct.
- H. Duct liner in roll form shall be folded and compressed in the corners of rectangular duct sections, or shall be cut and fit to assure a lapped, compressed corner joint
- I. Duct liner in sheet form shall be cut and fit to assure tight, over-lapped corner joints. Top pieces of liner shall be supported at the edges by the side pieces
- J. Any damage to the air stream surface must be repaired by coating the damaged area with adhesive or coating designed for duct liner application. Adhesive or coating shall meet requirements of ASTM C916.

3.07 FIELD QUALITY CONTROL (LINED DUCTWORK)

- A. Upon completion of installation of lined duct and before HVAC system start-up, visually inspect the ductwork and verify that duct liner has been correctly installed. Confirm that the duct system is free from construction debris.
- B. After the lined duct system is completely installed and ready for service, conduct a final inspection of the entire system. This inspection should include, at minimum, the following steps:
 - 1. Check all registers, grilles, and diffusers to ensure that they are clean and free from construction debris.
 - 2. Check all filters in accordance with their manufacturer's instructions. Use specified grade of filters at all times that system is operating.
 - 3. Cover supply openings with filter media prior to system start-up to catch any loose material that may remain inside the ductwork.
 - 4. Turn the HVAC system on and allow it to run until steady state operation is reached.
 - 5. Remove the temporary filter media from supply openings and, along with it, any loose material blown downstream and caught by the filter media.
 - 6. Check to ensure that air delivery performance meets all requirements and complies with SMACNA leakage specifications.

3.08 PROTECTION (LINED DUCTWORK)

- A. Contractor's employees shall be properly protected during installation of all insulation. Protection shall include proper attire when handling and applying insulation materials and shall include (but not be limited to) disposable dust respirators, gloves, hard hats and eye protection.
- B. The contractor shall conduct all job site operations in compliance with applicable provisions of the Occupational Safety and Health Act, as well as with all state and/or local safety and health codes and regulations that may apply to the work.

3.09 COLD AND RAIN LEADER PIPING INSULATION

- A. Insulate piping for domestic cold water, rain leaders, from primary and overflow roof drains, floor drains receiving condensate and piping leaving said floor drains using one-inch (1") Type "A" Insulation.
- B. Provide a complete vapor barrier throughout the entire system. Use only vapor barrier adhesives and coatings. Stapling of jacket not permitted. Penetrations in vapor barrier jacket, joints, and seams sealed vapor proof with Childers CP-35 or Foster 30-65 (white) mastic. **ALL ADHESIVES, SEALANTS AND COATINGS MUST MEET OR EXCEED GREEN BUILDING PROGRAM SCAQMD RULE 1168 AND 1113.**
- C. Cover ends of insulation sections with an adhesive coating at intervals of not more than twenty feet (20'). Insulate accessories, valves, flanges, etc.
- D. Cover insulation on fittings with spiral-wrapped glass mesh tape. Finish with a vapor barrier coating applied approximately 1/16" thick.

- E. Insulate ALL horizontal and vertical runs for primary and overflow roof drain rain leader piping from bottom of roof deck to include roof drain body, to the exit of the building.
- F. Insulate all cold-water piping above ceiling to point where piping turns down into chase. When piping turns down into exterior walls, piping in exterior walls must be insulated.

3.10 HOT & TEMPERED PIPING INSULATION

- A. Insulate domestic hot and tempered water and circulating lines using one inch (1") Type "A" insulation one inch (1") thickness for ½" to one inch (1") piping, 1-1/2" thickness for 1-1/4" to two inch (2") piping and two inch (2") thickness for 2-1/2" to six inch (6") piping.
- B. Staples may be used to seal jacket.
- C. Insulate unions, valves and flanges in boiler room only for piping over 140° F. Insulate with same method used for cold pipe fittings, except vapor barrier mastic is not required.
- D. Do not insulate valves, flanges, and unions for domestic hot water piping systems below 140° F., but bevel and seal ends of insulation at such locations.
- E. Insulate hot water expansion tank and air separators with one-inch (1") sheet type "B" insulation.

3.11 SPECIAL PIPING INSULATION REQUIREMENTS

- A. Crawl Space Piping – Ventilated Attics – Piping Located Exterior to Building
 - 1. All Cold Water, Chilled Water, Waste Carrying Condensate, SHALL ALL USE TYPE 'H' FOAM GLASS TYPE INSULATION with PVC jacket. Minimum 2" or thicker as required by manufacturer and temperature difference to prevent condensation. All other sealing specifications apply.
 - 2. ALL water carrying piping, SHALL ALL USE TYPE 'H' FOAM GLASS TYPE INSULATION with PVC jacket. Minimum 2" or thicker as required by manufacturer and temperature difference to prevent condensation. All other sealing specifications apply.
 - 3. Insulate p-trap of all floor drains and deep seal traps that receive condensate below first floor when there is a crawlspace or basement. Insulate piping down to main tie in point. Insulate with 2" thick Type "H" Insulation.
 - 4. Roof Mounted Condensate piping (excluded from this requirement).
- B. Insulate buried domestic hot and cold-water lines under building with one-inch (1") Type "B" Insulation. Bond joints using an adhesive; apply surface treatment as recommended by insulation manufacturer, taping not permitted. Set in sand bed and cover with minimum five inches (5") sand. **ALL ADHESIVES, SEALANTS AND COATINGS MUST MEET OR EXCEED GREEN BUILDING PROGRAM SCAQMD RULE 1168 AND 1113.**
- C. **Insulate all refrigerant piping for heat pump and heat recovery systems and suction lines only for all other systems with Type "B" Insulation:** ½" thickness for piping up to 1" and 3/4" thickness for piping larger than one inch (1"), apply per manufacturer's recommendations. Glue all joints and seams with Armaflex 520 Adhesive BLV LOW VOC. All insulation located outside must be Armacell Armaflex Shield with UV-Resistant durable protective jacket. If piping is serving VRF or minisplit heat pump, provide Armaflex UT with additional coating of WB UV protection. Refrigerant piping outdoors to be insulated and covered with an aluminum jacket with seams located on bottom side of horizontal piping. Jacketing to be neatly installed. No tape is allowed.

ALL ADHESIVES, SEALANTS AND COATINGS MUST MEET OR EXCEED GREEN BUILDING PROGRAM SCAQMD RULE 1168 AND 1113.

- D. Insulate all exposed p-traps and water connections for handicapped lavatories with White "Truebro Handi Lav-Guard" Insulation Kit Model #102W (Use Model #105W when 5" offset strainer is used). (Phone: 203-875-2868), or equal products as manufactured by Brocar Products Inc., (Phone: 512-847-1524).
- E. Insulate p-trap of all floor drains above the first floor and deep seal traps that receive condensate. Insulate piping down to main tie in point. Insulate with 1" thick Type "B" Insulation or 1" type "A" insulation

3.12 DUCT INSULATION REQUIREMENTS

A. Insulate Ducts as Follows:

1. Thickness and Type:

- a. Exhaust Air and Outside Air Exhaust Ducts: Externally wrap with Type "C" Insulation; insulate from roof deck/wall exterior back three feet (3') into space. (R-6)
- b. Rooftop Units: Internally line rooftop unit supply and return air drops past first ninety-degree elbow for a minimum of four feet (4'), reference Specification Section 20 07 00, 2.03, Sound Control for Liner. Provide access door in duct risers for access and cleaning. Minimum size 18 x 18. (Exception: Rooftop unit serving kitchen is to have the supply air drop internally lined and the return air drop externally wrapped with Type "C" Insulation.). R-8 for ductwork located outside or in attic spaces and R-6 for all other ducts inside the building insulation envelope.
- c. Supply Air: Externally wrapped with Type "C" Insulation, unless specifically noted otherwise. Internally lined per Section 20 07 00, where noted, first 48" past first 90-degree fitting on RTU and 48" from AHU. R-8 for ductwork located outside or in attic spaces and R-6 for all other ducts inside the building insulation envelope.
- d. Return Air: Externally wrapped with Type "C" Insulation, unless specifically noted otherwise. Internally lined per Section 20 07 00, where noted, RTU duct drop insulated per detail, AHU return air box within 48" of unit. R-8 for ductwork located outside or in attic spaces and R-6 for all other ducts inside the building envelope.
- e. Outside Air: Supply ducts externally wrapped with Type "C" Insulation. R-8 for ductwork located outside or in attic spaces and R-6 for all other ducts inside the building insulation envelope.
- f. Relief Air: Externally wrap with Type "C" insulation when run through unconditioned spaced, unless specifically noted otherwise. R-8 for ductwork located outside or in attic spaces and R-6 for all other ducts inside the building insulation envelope.
- g. Air Devices: Externally wrap backs of all supply, return and exhaust air devices including square to round adapters and boots with Type "C" Insulation. Properly seal all edges. Use R-8 insulation for air devices with backs outside of building insulation envelope and R-6 insulation when backs of air devices are located

inside building insulation envelope.

- h. Grease Rated Kitchen Exhaust: Shall be installed in one (1) hour enclosure with minimum three inches (3") clear, maximum twelve inches (12") clear, reference Architectural. Coordinate access doors with enclosure. As an option to installing grease rated exhaust duct in a one (1) hour enclosure, insulate with Type "F" insulation installed to meet manufacturer's written instruction for this application.
- i. Kitchen Supply: Type "C" or Type "D" Insulation. R-8 for ductwork located outside or in attic spaces and R-6 for all other ducts inside the building insulation envelope.
- j. Exterior Ductwork: R-8 Type "E" and/or duct liner insulation.
- k. Special circumstance as noted: R-6 or R-8 Type "G" duct liner insulation.

3.13 CONDENSATE PIPING INSULATION

- A. Condensate piping to be insulated with Type "B" Insulation 1/2" thick. Entire condensate system to be insulated when run inside building or in crawlspace/basement. When copper or steel pipe is used outdoors insulate only to a point 2' downstream of trap unless piping turns down into building to termination point. If it does insulate the whole run of piping.
 - 1. Apply per manufacturer's recommendations. Glue all joints and seams with Armaflex 520 BLV LOW VOC Adhesive. No tape will be allowed. Auxiliary condensate not required to be insulated. Protect all insulation on piping outside with two (2) coats of "WH" Armaflex Finish Coating for weather protection. **ALL ADHESIVES, SEALANTS AND COATINGS MUST MEET OR EXCEED GREEN BUILDING PROGRAM SCAQMD RULE 1168 AND 1113.**

END OF SECTION

SECTION 21 00 00 - FIRE PROTECTION

PART 1 - DESCRIPTION

1.01 DESCRIPTION

A. Description:

1. This section describes specific requirements, products and methods of execution relating to fire protection for the project.
2. Temporary occupancy permits, or partial occupancy require alarm and life safety systems to be fully operational. Expedite installation and complete life safety requirements for temporary occupancy.

B. Scope: Provide a system of fire protection, complete in every detail and in perfect operating order, in accordance with the contract documents and applicable codes and standards to protect the areas noted, including all piping, valves, backflow preventers, sprinkler heads, heat shields, fire department connections, alarm valves, flow switches, hangers, supports, pertinent accessories, etc. for a complete turnkey job.

1. New Construction : Provide Complete system.
2. This is a performance specification. Construction and installation drawings and hydraulic calculations shall be prepared according to standard practice, by a Sprinkler designer under the supervision of a State of Texas licensed RME-G or a Professional Engineer. Change in installation necessary due to lack of coordination with other trades shall be made without additional cost to the Owner. Verify final location of all exposed piping with the Architect.
3. Coordinate final location of Fire Department Connection (FDC) with local Fire Marshall. Provide all piping and materials required for installation of FDC.
4. Provide Class I standpipe system in stairways and at locations if required in accordance with IFC and NFPA 14. Fire hose threads used in connection with the standpipe systems shall be approved and shall be compatible with fire department hose threads. Final location of fire department hose connections shall be approved by Fire Marshal and coordinated with Architect.
5. Provide Class III standpipes in stages greater than 1,000 square feet as required by IFC and NFPA 14. Fire hose threads used in connection with the standpipe systems shall be approved and shall be compatible with fire department hose threads. Final location of fire department hose connections shall be approved by Fire Marshal and coordinated with Architect.
6. Sprinkler Contractor to begin work at flanged stub 12" A.F.F. provided by site utility contractor in Fire Riser Room. Coordinate final size and stub location with site utility contractor.
7. Provide AMES Fire and Waterworks Series 1BR In-Building Riser, single piece, stainless steel, with all NFPA 24 and code required thrust blocking/rod anchoring, coordinate with soil conditions. When expansive soils are present provide 'EBAA Iron INC. "FLEX-TEND FORCE BALANCED FLEXIBLE EXPANSION JOINT". Size to match fire line size. If soil conditions are unknown at time of bid, include in base price and provide deductive

alternate to be removed from scope when soil conditions are known. Installation to be by Fire Protection Contractor or Site Utility Contractor with 'SCRU' License. Installation to be per NFPA 24 "Standard for Installation of Private Fire Main.

- C. Provide the following type fire protection in the areas noted:
 - 1. Provide a wet and/or dry pipe sprinkler system (light hazard pipe schedule) to protect the entire building as required. Hazard type shall be as required by FM Global, NFPA-13, International Fire Code and as required by the Owner's Insuring Agency.
 - 2. Provide a dry pipe system in any areas subject to freezing.
 - 3. Remodel areas receiving new ceilings shall have new heads as defined in this specification and treated as new construction to match all additions. Existing pendant heads shall not be reused on new ceilings.
- D. SPECIAL NOTE: All provisions and divisions of these specifications are a part of this section of these specifications. The Contractor shall consult these divisions and provisions in detail for instructions and include all items pertaining to this work. The Contractor shall consult all other divisions of these specifications, determine the extent of impact on the work required to complete the work required by this section of the specifications or portion thereof and related work shown on the drawings.
- E. Provide floor sink in each sprinkler riser room.
- F. Submit shop drawings for the fire sprinkler system to the local Fire Department for review prior to installation.

1.02 Provide all fire protection in accordance with the minimum provisions of the latest approved edition of the following codes and standards.

- A. NFPA 13 - Latest approved edition, Sprinkler Systems.
- B. Latest approved edition of the International Fire Code.
- C. Latest approved local ordinances and amendments.

1.03 SUBMITTALS AND APPROVALS

- A. Review and Approvals Required:
 - 1. Obtain written review and approval of the entire fire protection system design and arrangement from the following authority:
 - a. State Fire Marshall (Approval)
 - b. Owner's Insuring Authority (Approval)
 - c. Architect (Approval)
 - d. Mechanical Engineer (Review)
 - 2. Provide construction drawings, calculations, details and all other data required by the above authority for approval.

B. Submittals:

1. Provide complete fire protection systems construction drawings and calculations for the entire project.
2. Obtain and verify the high and low static water pressure and the residual pressure at full flow at the point of connection to the water utility systems or at a nearby point acceptable to the approval authority. Obtain data from flow tests or system network design calculations of reliability acceptable to the approval authority. Use this data in flow calculations and include it with submittal of calculations.
3. Include the following on the construction drawings:
 - a. Location of water source, routing and size of supply piping.
 - b. Location of key gate valves.
 - c. Detector check valves.
 - d. Fire department connections.
 - e. All necessary controlling equipment.
 - f. Location of flow alarm valves.
 - g. All distribution system piping and outlets.
 - h. Reflected ceiling plan showing proposed location of sprinkler heads and other outlets.
 - i. Interference control between work of other trades.
 - j. Indicate connection points for Fire Alarm Contractor and provide letter indicating coordination has been done with Fire Alarm Contractor.
 - k. Provide 1/4" shop drawing of sprinkler entrance and valve assemblies to ensure adequate space.
4. Submit six copies of fire protection drawings reviewed and approved by the Administrative Authority to the Architect for further approval. Include all correspondence with the Administrative Authority.
5. Obtain approval of Architect prior to ordering, fabricating or installing any part of the system. Head locations are subject to this review and approval.

1.04 COORDINATION REQUIRED

- A. Check all dimensions indicated on the Architectural or structural drawings and verify dimensions at the site before fabricating any portion of the system. Any discrepancies in piping and head locations resulting from failure to so check shall be corrected expeditiously to provide proper coordination of all trades.
- B. Coordinate work with that of other crafts to ensure that adequate space is provided for all work, including requirements for accessibility and serviceability. Locate sprinkler heads to avoid conflict with light fixtures and other installed equipment, and center location of piping and heads in field to accomplish these requirements for coordination.

- C. Coordinate with Mechanical Shop Drawings to avoid ducts from RTU's and other main runs.
- D. Do not install any piping over electric rooms, electric equipment, MDF/IDF/Technology rooms or racks. Only piping serving electric/technology rooms may enter electric rooms and should enter over doorway.

1.05 FINAL INSPECTION AND APPROVAL

- A. After installation is complete, obtain inspection and letter of approval of system stating that sprinkler system complies with all requirements for a fully sprinklered building.

1.06 ACCEPTABLE SUPPLIERS

- A. Furnish the services of a qualified and approved fire protection subcontractor to provide the work of this specification section. Unless otherwise noted, this is substantially a "performance" specification.
- B. Subcontractor minimum qualifications include:
 - 1. Maintain a complete engineering, sales, installation and service organization that has operated within the Austin/San Antonio area for at least three years prior to bid date of this project.
 - 2. Maintain a complete stock of replacement parts.
 - 3. Remain on 24-hour call for emergency service.
 - 4. Demonstrate satisfactory completion of three projects of similar size and scope. Provide references if required.
 - 5. Bids by wholesalers, Contractors or any firm whose principle business is not that of manufacturing and/or installing fire protection systems are not acceptable.

1.07 MAINTENANCE INFORMATION AND INSTRUCTION

- A. Reference Section 20 00 00.
- B. Include instruction charts describing operation and proper maintenance of fire protection devices.
- C. Include publication entitled: "Care and Maintenance of Sprinkler Systems", NFPA No. 13-latest approved edition.

PART 2 - PRODUCTS

- 2.01 General: Provide only products which are a standard product of a manufacturer regularly engaged in the fire protection application where they are used.
- 2.02 Labels and Approvals for Products: All products UL or FM listed, labeled and specifically approved for the fire protection application where they are used.

2.03 PIPE AND FITTINGS

A. Water Systems:

1. Piping system materials shall be currently recognized by NFPA 13 and must be listed for the intended service by UL or FM. Furnish steel pipe and fittings of domestic manufacturers only.

2.04 VALVES

- A. All valves UL listed and labeled and specifically approved for the fire protection application where they are used. Minimum working pressure 175 psi non-shock cold water.

2.05 SPRINKLER HEADS; FINISHED AREAS

- A. General: Heads of temperature rating required by NFPA 13, suitable for system type. **USE FLEXIBLE TYPE SPRINKLER HEAD CONNECTION ONLY.**
- B. Concealed Quick Response Type: With coverplate and spring-loaded clips, color as approved by Architect. Reliable G4QR concealed with cover to be used in all ceilings unless otherwise noted.
- C. Quick Response Dry Pendant Type: For use in freeze applications. Reliable Model G3FR.
- D. Institutional Heads: For cell and other secure type areas. Flush style type to conceal operating parts except for sensor, Conical Escutcheon Assembly attached to sprinkler body with tamper resistant fasteners. Pendant or side wall mount as applicable. Use side wall in cell areas. Reliable Model ZX-OR-IWST.
- E. Pendant Type: For the Gym and Maintenance Areas use Quick Response Type, Reliable Model F1FR. Use sprinkler guards on sprinkler heads in Gym Area.
- F. Manufacturers: Chemetron, Reliable, Grinnell or approved equal.

2.06 SPRINKLER HEADS; UNFINISHED AREAS

- A. General: Heads of temperature rating required by NFPA 13; plain finish suitable for system type.
- B. Type: Fusible link, equal to Reliable Model A.
- C. Manufacturers: Reliable, Grinnell, approved equal.

2.07 FIRE DEPARTMENT CONNECTION (FDC)

- A. FDC: Cast brass body and trim having individual 2-1/2" double female snout inlets with rigid end NPT with pin lug hose thread swivels, plugs, and chain; outlet size as required; exposed parts polished brass (chrome-plated); horizontal flush mounting; Potter Roemer 5020 Series or approved equal. Coordinate final requirements and locations of FDC with Fire Marshal.
- B. Provide appropriate lettering on escutcheon plate, to identify connection.
- C. Provide hose threads to match the threads of the local fire department.
- D. Provide Knox Caps per Fire Department requirements.

2.08 SPRINKLER ALARM VALVE ASSEMBLY

- A. Provide sprinkler alarm valve assemblies, appropriate to the system, complete with all trimmings and accessories for proper alarm initiation and interface with fire alarm system. Include inlet and discharge pressure gauges, main drain and inspectors test connection.
- B. Alarm Gong: Provide a 10" diameter water powered alarm bell, confirm location with Architect.

2.09 WATER FLOW DETECTORS

- A. Provide flow switches or water flow detectors as required. Provide switches compatible with fire alarm system.
- B. Electrical connection by Electrical Contractor. Coordinate location and quantity with Electrical Contractor.

2.10 VALVE TAMPER SWITCHES

- A. Furnish UL listed and FM approved, series NGV supervisory switch for OS & Y valve installation with two single pole, double throw microswitches. The mechanism shall be contained in a red baked enamel, weatherproof housing and shall incorporate the necessary facilities for attachment to valves. The switch mechanism shall be compatible with the fire alarm system. The entire installed assembly shall be tamperproof and arranged to cause switch operation if the housing cover is removed or if the unit is removed from its mounting. Install supervisory switches and furnish all wire and conduit required from supervisory switch to the alarm panel. Furnish a set of additional alarm contacts for additional supervisory capability.
- B. Manufacturers: Potter Electric Signal Co., Model OSYS-B or approved equal.
- C. Electrical connection by Electrical Contractor. Coordinate location and quantity with Electrical Contractor.

2.11 INSPECTORS TEST CONNECTIONS

- A. Provide inspectors test connections for complete system testing and as required for final approval by inspecting authority.
- B. Chemoplate all portions of pipe and fittings exposed outside building; provide chrome-plated set screw escutcheon.

2.12 DRY SYSTEM

- A. Provide Nitrogen Generator System for all Dry Zones.
 - 1. Basis of Design – South Tek (www.southteksystems.com)
 - a. FPS – xxx (sized for system)
 - b. Quick Check Purity Manifold (sized for system)
 - c. Provide with Auto Purge
 - d. Provide appropriately sized air compressor for system to have 30 min max charge time.

- B. Provide UL approved low air pressure alarm switches on each dry system, compatible with fire alarm system.
- C. Electrical connection is described in Division 26-28 work. Coordinate location and quantity with Electrical Contractor.

2.13 BACKFLOW PREVENTER

- A. Provide UL and FM approved reduced pressure zone (RPZ) double check backflow flow preventer equal to Ames Silver Bullet style inside building at fire entry point. Provide shop drawing indicating space requirements. Pipe RPZ relief to nearest floor sink.

2.14 FIRE PUMP SYSTEMS

- A. Furnish and install a complete fire pump system complete with pump, driver, controller, jockey pump accessories. The pumping unit shall be listed by Underwriter's Laboratories, Inc. and fully approved by the Associated Factory Mutual Fire Insurance Companies. The pumping unit shall meet all requirements of the National Fire Protection Association Pamphlet No. 20. The fire pump shall be designed to deliver a required G.P.M. and pressure to meet NFPA flow requirements for building. Contractor to verify city pressures.
- B. The driver shall be an open drip-proof (or T.E.F.C.), ball bearing type, AC, induction, squirrel cage motor, wound for 480 volts, 3 phase, 50 hertz. The motor shall be of such capacity that 115% of the full-load ampere rating shall not be exceeded at any condition of pump load for U.L. listed fire pump systems and 110% of full-load for F.M. approved fire pump systems. Locked rotor current shall not exceed the values specified in NFPA Pamphlet No. 20.
- C. Pump and motor shall be mounted on a common baseplate of steel with drip rim. Pump and motor shall be checked for alignment after the pump base has been installed and grouted in place.
- D. All pumps where the suction pressure is expected to average 40 P.S.I. or below, shall be provided with lantern ring connected to the pressure side of the pump by a cored passage in the parting flange of the pump. Stuffing boxes shall be equipped with split bronze packing glands designed for easy removal for packing inspection and maintenance.
- E. The fire pump service rated motor control shall be U.L. listed and F.M. approved. It shall be completely assembled, wired and tested by the control manufacturer before shipment from the factory, and shall be labeled "Fire Pump Controller". Fire pump controller shall have over current protection to handle locked rotor amp of fire pump. The controller shall be located as close as practical and within sight of the motor. The controller shall be so located or protected that it will not be injured by water escaping from the pump or connections. The controller shall be of the combined manual and automatic across-the-line type, and shall be complete with disconnect switch – externally operable, quick break type, circuit breaker – time delay type with strips in all places set for 300% of the motor full-load current motor starter – across-the-line type capable of being energized automatically through the pressure switch or manually by means of an externally operable handle, pressure switch, running period timer – set to keep motor in operation, when started automatically, for testing as required by code. (Control equipment shall meet all requirements of NFPA No. 20.)
- F. Provide ¼" scale shop drawing of fire pump room. Indicating fire pump, piping controller and jockey pump.
- G. Manufacturers: Aurora, Suncroflo or equal.
- H. Coordinate all final electrical requirements with Electrical Contractor.

- I. Coordinate final room size with Architect.
- J. Provide alternate to provide MIC Control System to aid in reducing degradation.

PART 3 - EXECUTION

- 3.01 Install all work in accordance with codes and recommended practices for this type of work.
- 3.02 Conceal all piping possible. Coordinate with the other trades to take timely advantage of available space above ceilings, in pipe and duct spaces, and elsewhere.
- 3.03 Provide access doors where "Fire Protection" valves, switches, or other controlling or monitoring devices are concealed. Label doors for quick location and recognition of concealed device.
- 3.04 Advise the Architect immediately of any conflicts between the plans and specifications. Clearly explain problem, limits of problem, and proposed solution.
- 3.05 Center sprinkler heads in ceiling tiles in both directions. Coordinate exact placement with diffusers, light fixtures and other ceiling mounted devices.
- 3.06 **Sprinkler heads shall not be painted.**
- 3.07 Provide as-built drawings indicating location of zones.
- 3.08 FLUSHING AND TESTING
 - A. Flush underground service piping and distribution piping before connecting underground piping to sprinkler system.
 - B. Arrange for proper witnessing of all tests as required by codes and authorities.
 - C. Make all tests in accordance with applicable codes. Test piping at minimum 200 psig hydrostatic for two hours. Flush as required by NFPA.
 - D. Provide a letter of certification stating that all testing and flush has been performed in accordance with the applicable codes and standards. Itemize codes and standards complied with.
- 3.09 All sprinkler piping is to be routed in conditioned space to prevent freezing and concealed above ceiling, furr-outs or other Architectural features whenever possible. Coordinate changes in elevation, piping between floors and adjoining spaces with Architectural drawings to ensure that piping will not be exposed to finished spaces. **Any piping that must be exposed is to be coordinated with Architect and indicated on shop drawings.**
- 3.10 DRY SPRINKLER SYSTEM
 - A. Air Compressor: Confirm final electrical requirements with Electrical Contractor(min 20amp-120v dedicated circuit). Compressor must have adequate vibration isolation so that no vibrations are transmitted to the structure or slab.
 - B. Nitrogen Generator: Confirm final electrical requirements with Electrical Contractor(min 20amp-120v dedicated circuit). If large system coordinate 208volt connection.
 - C. Provide start-up and test report showing proper functioning of Nitrogen systems, Purity Manifold operation and monitoring, including final Nitrogen Content.

- D. Provide all piping and controls associated with air compressors.
- E. Arrange wiring for single point connection, for each piece of equipment.

3.11 REMODEL AREA

- A. Provide new heads in ALL remodel areas to match new construction standards and aesthetics based on this specification.

END OF SECTION

**SECTION 22 01 00 - INSIDE UTILITY TRENCH EXCAVATION,
BACKFILL AND COMPACTION**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section describes general requirements, products, and methods of execution relating to excavation, backfill and compaction of inside trenches for mechanical work. Inside trenches are those which occur within an arbitrary, imaginary boundary five feet beyond the outside perimeter of the structure.
- B. Scope: Provide all trench work for mechanical work of every description and of whatever substance encountered to the depth indicated, or to provide pipe slopes and elevations shown on the drawings. Excavate and backfill utility trenches. Place and compact bedding material. Compact backfill material.
- C. SPECIAL NOTE: All provisions and divisions of these specifications are a part of this section of these specifications. The Contractor shall consult these divisions and provisions in detail for instructions and include all items pertaining to this work. The Contractor shall consult all other divisions of these specifications, determine the extent of impact on the work required to complete the work required by this section of the specifications or portion thereof and related work shown on the drawings.

1.02 APPLICABLE CODES

- A. Local Codes and Ordinances
- B. Texas Safety Standards
- C. OSHA - Section 1926.650

1.03 SAFETY PRECAUTIONS AND PROGRAMS

- A. It shall be the duty and responsibility of the Contractor and all of its subcontractors to be familiar and comply with all requirements of Public Law 91-696, 29 U.S.C. Secs. 651 et. seq., the Occupational Safety and Health Act of 1970, (OSHA) and all amendments thereto, and to enforce and comply with all of the provisions of this Act. IN ADDITION, ON PROJECTS IN WHICH TRENCH EXCAVATION WILL EXCEED A DEPTH OF FIVE FEET, THE CONTRACTOR AND ALL OF ITS SUBCONTRACTORS SHALL COMPLY WITH ALL REQUIREMENTS OF 29 C.F.R. SECS. 1926.652 AND 1926.653, OSHA SAFETY AND HEALTH STANDARDS.

PART 2 - BEDDING MATERIAL

2.01 BEDDING MATERIAL

- A. Select bedding material from trench excavation using care to separate it from unsuitable material. If suitable bedding material is not available from trench excavation, import it from sources approved by the Architect.
- B. Use clean sand. Maintain moisture content within a range that will allow specified compaction.

2.02 TRENCH BACKFILL

- A. Obtain trench backfill material from trench excavation. If sufficient suitable trench backfill material compatible with structural backfill is not available from trench excavation, import it from sources approved by the Architect.
- B. Use granular material, free from large stones, boulders and debris. Maintain moisture content within a range that will allow specified compaction. Maximum aggregate size four inches (4").

PART 3 - EXECUTION

3.01 EXCAVATION

- A. Place all excavated material suitable for backfill in an orderly manner, and in conformance with safety codes.
- B. Dispose of all material not suitable for backfilling.
- C. Form bell holes so pipelines rest on continuous undisturbed soil. If larger rocks or boulders are encountered, remove them. If trenches are below specified grade, backfill to required depth with select granular materials free from debris and rock, and compact to proper grade before installing piping.
- D. Follow manufacturer's recommendations for minimum trench width, material type and cover requirements.

3.02 LOCATION

- A. Locate trenches to accommodate utilities shown on the drawings.
- B. Construct trench with adequate width to allow compaction equipment to be used at the sides of pipes.
- C. Make trench side slopes conform to prevailing safety code requirements.

3.03 DEWATERING

- A. Perform whatever work is necessary to prevent the flow and accumulation of surface or ground water in the excavation.

3.04 TIMING

- A. Do not backfill until underground mechanical system has been properly tested, inspected and approved.
- B. Coordinate with the work of others and complete all trench work in a timely manner.

3.05 BEDDING

- A. Place bedding material under, around, and over the pipe in lifts not exceeding 8" in depth.
- B. Work material around pipe by hand methods, taking care to keep any oversize or sharp stones out of contact with the pipe, and to provide uniform support for the pipe.

- C. Cover pipe with bedding material to building subgrade or to a minimum 12" depth before adding other backfill.

3.06 BACKFILLING

- A. Continue placing backfill material until trench is completely filled to building subgrade, or as shown on the drawings.
- B. Place backfill material in lifts not to exceed 12" in depth.

3.07 COMPACTION

- A. Compact all bedding material to at least 95% of maximum density, taking care not to damage the pipe.
- B. Compact all backfill under footings, slabs, and other structures to 95% of maximum density or more, if required by the Architect.
- C. Compact other areas to preclude future settlement, or at least 85% of maximum density.

3.08 FINISHING

- A. After completion of backfilling, dispose of excess material and smooth the surface to grade.
- B. Do not allow heavy equipment to be used over backfilled work that does not have sufficient cover to prevent pipe damage.

3.09 SPECIAL PRECAUTIONS

- A. Avoid unauthorized and unnecessary excavations.
- B. Minimize number and size of excavations under footings or bearing walls.
- C. Support footings, foundations, and walls with timbers and jacks if there appears to be any possible chance of damage and keep such precautions in place to eliminate possible damage.
- D. Backfill under footings and bearing walls, using maximum compaction or concrete of proportions as specified for footings.
- E. Avoid damage to all existing underground services, foundations, cables, conduit lines or foundations. Repair any existing underground work accidentally damaged at no additional cost to the Owner.

3.10 UNDER EXISTING SLAB INSTALLATION

- A. When breaking out an existing floor slab, make a saw cut and remove concrete. When repouring concrete, compact the fill to the same specifications as the building fill. Re: Architectural/Structural. General Contractor to make necessary saw cuts and patching as required.
Coordinate penetrations of existing grade beams with structural engineer.

3.11 UNDER SLABS ON VOID FORMS:

- A. Piping installed in expansive soil conditions or where slabs are required to be protected from expansive soils, have two installation options.

1. Structured Slab: Pipes must be suspended from structured slab in crawl space. Isolated from expansive soils. Must provide flexible connections at all civil or building perimeter connections where there is a transition from suspended to expansive soil. (CW, Waste, Storm, Fire etc...) Coordinate acceptable types with structural and plumbing documents.
2. Slab on Void: Pipes must be protected / isolated from expansive soil when slab must be protected. When this Slab construction is used. The Basis of Design for plumbing protection is "Mud Skipper". Alternative must be approved prior to acceptance. Must provide flexible connections at all civil or building perimeter connections where there is a transition from suspended to expansive soil. (CW, Waste, Storm, Fire etc...) Coordinate acceptable types with structural and plumbing documents.

END OF SECTION

**SECTION 22 02 00 - OUTSIDE UTILITY TRENCH EXCAVATION,
BACKFILL AND COMPACTION**

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Related Work Specified Elsewhere:
 - 1. Section 20 00 00 - General Provisions
 - 2. Section 20 01 00 - Basic Materials and Methods
 - 3. Division 2 - Site Work
- B. Description: This section described general requirements, products, and methods of execution relating to excavation, backfill, and compaction of utility trenches outside of buildings. The arbitrary line of demarcation between inside and outside of buildings occurs 5' outside the building perimeter.
- C. It shall be the duty and responsibility of the Contractor and all of its subcontractors to be familiar and comply with all requirements of Public Law 91-696, 29 U.S.C. Secs. 651 et. seq., the Occupational Safety and Health Act of 1970, (OSHA) and all amendments thereto, and to WHICH TRENCH EXCAVATION WILL EXCEED A DEPTH OF FIVE FEET, THE CONTRACTOR AND ALL OF ITS SUBCONTRACTORS SHALL COMPLY WITH ALL REQUIREMENTS OF 29 C.F.R. SECS. 1926.652 AND 1926.653, OSHA SAFETY AND HEALTH STANDARDS.
- D. SPECIAL NOTE: All provisions and divisions of these specifications are a part of this section of these specifications. The Contractor shall consult these divisions and provisions in detail for instructions and include all items pertaining to this work. The Contractor shall consult all other divisions of these specifications, determine the extent of impact on the work required to complete the work required by this section of the specifications or portion thereof and related work shown on the drawings.

PART 2 - PRODUCTS

2.01 BEDDING MATERIAL

- A. Select bedding material from trench excavation using care to separate it from unsuitable material. If suitable bedding material is not available from trench excavation, import it from sources approved by the Architect.
- B. Use granular material, free from large stones, boulders and debris. Maximum aggregate size passing a 2" sieve opening. Maintain moisture content within a range that will allow specified compaction.

2.02 TRENCH BACKFILL

- A. Obtain trench backfill material from trench excavation. If sufficient suitable trench backfill material is not available from trench excavation, import it from sources approved by the Architect.
- B. Use granular material, free from large stones, boulders and debris. Maintain moisture content within a range that will allow specified compaction. Maximum aggregate size 4 inches.

PART 3 - EXECUTION

3.01 EXCAVATION

- A. Excavate trenches to depth and grades as shown on drawings.
- B. Place all excavated material suitable for backfill in an orderly manner and in conformance with safety codes.
- C. Dispose of all material not suitable for backfilling.
- D. Form bell holes so pipelines rest on continuous undisturbed soil. If larger rocks or boulders are encountered, remove them. If ground surface is below specified pipe grade, fill to required depth with granular materials free from debris and rock, and compact to proper grade before installing piping.

3.02 LOCATION

- A. Locate trenches to accommodate utilities shown on the drawings.
- B. Construct trench with adequate width to allow compaction equipment to be used at the side of pipes.
- C. Make trench side slopes conform to prevailing safety code requirements.

3.03 DE-WATERING

- A. Perform whatever work is necessary to prevent flow and accumulation of surface or ground water in the excavation.

3.04 TIMING

- A. Do not complete backfill until utility system has been properly tested, inspected, and approved.
- B. Coordinate with the work of others and complete all trench work in a timely manner.

3.05 BEDDING

- A. Place bedding material under, around, and over pipe in lifts not exceeding 8" in depth.
- B. Work material around pipe by hand methods, taking care to keep any oversize or sharp stones out of contact with the pipe, and to provide uniform support for the pipe.
- C. Cover pipe with bedding material to a minimum 6" depth before adding other backfill.
- D. Cover water line with 18" bedding material before backfilling.

3.06 BACKFILLING

- A. Continue placing backfill material until trench is completely filled to finished grade, or as shown on the drawing.
- B. Place backfill material in lifts not to exceed 12" in depth.

3.07 COMPACTION

- A. Compact all bedding material to at least 95% of maximum density, taking care not to damage the pipe.
- B. Compact backfill material to preclude future settlement or at least to 90% of maximum density.

3.08 FINISHING

- A. After completion of backfilling, dispose of excess material and smooth the surface to grade.
- B. Restore all surface areas to original conditions or improve as shown on the drawings. Replace all paving, base course, gravel surfacing, sub-base, topsoil or other existing finished surface as shown on drawings.
- C. Clean up and finish all construction areas to original condition or better.

END OF SECTION

SECTION 22 11 16 - WATER DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section describes specific requirements, products and methods of execution relating to the domestic water distribution system for the project.
- B. The work of this section includes: All water distribution work inside the structure, and all outside distribution work up to and including connection to the water source, including provision of the outside water source, or water using apparatus, although the work of this section does include the interface connections at all of these related items.
- C. SPECIAL NOTE: All provisions and divisions of these specifications are a part of this section of these specifications. The Contractor shall consult these divisions and provisions in detail for instructions and include all items pertaining to this work. The Contractor shall consult all other divisions of these specifications, determine the extent of impact on the work required to complete the work required by this section of the specifications or portion thereof and related work shown on the drawings.

1.02 CONNECTION TO UTILITY WATER SYSTEM

- A. Coordinate with site utilities to properly locate and interface with the water supply. Stub water 5'-0" outside the building and make connection to water supply. See Civil Drawing for site utility locations.
- B. When No Civil Engineer: Coordinate with site utilities to properly locate the water supply and make the connection in accordance with approved practices. Obtain all permits, pay fees, and provide all service incidental to this work.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS ABOVE GROUND (INSIDE STRUCTURE)

- A. Type "K" or "L" hard drawn copper tubing, wrought solder type fittings, lead free (0.00% lead content) solder or brazed or press fit joints by Viega, Nibco or Apollo.

2.02 PIPING AND FITTINGS BELOW GROUND

- A. 2" and Smaller:
 - 1. Type "K" soft copper, wrought bronze solder type fittings, lead free (0.00% lead content) solder.
 - 2. Use heavy duty Water-Tite-Sleeve as manufactured by IPS Corporation for all piping under slab. Sleeves for 1" and under shall be 25 mil., blue for cold water and red for hot water. Sleeves for 1 1/4" to 2" shall be 6 mil., black in color.
- B. 2-1/2" and Larger:
 - 1. Type "K" hard drawn copper, wrought bronze solder type fittings, lead free (0.00% lead content) solder.

- C. No joint to be installed under building slab.
- D. When No Civil Engineer: PVC Schedule 40 thermoplastic pipe may be used as allowed by code and/or governing authority from a point 5' from building to source of water supply. All fittings to be Schedule 80 PVC.

2.03 WATER METER

- A. Reference Civil Drawings

PART 3 - EXECUTION

3.01 GENERAL METHODS

- A. Make all joints in accordance with manufacturer's recommendations. The tools used shall be the tools adapted to that specific purpose.
- B. At all fixtures, install and connect hot water on left and cold water on right, as viewed when facing the fixture.
- C. Where required for connections to fixtures, equipment items, etc., employ lengths of red brass pipe with threaded ends of copper to IPS adapters, brass couplings, etc., to the end that there shall be no ferrous pipe in any water piping system.
- D. Provide valves on each branch line at the point of connection into the supply and circulating mains serving all batteries of plumbing fixtures. Provide stop valves in each water supply for every plumbing fixture. Each hose bibb is to have an individual shut off valve, separate from valves that would shut down a battery of fixtures. Valves for piping two inches (2") and smaller shall be ball valves.
- E. Provide water hammer arrestors with accessible isolation valve on cold water and hot water supplies to ALL plumbing fixtures. Provide access door for all concealed arrestors. Water Hammer Arrestors shall be certified by the Plumbing and Drainage Institute (PDI) Standard WH-201. **Arrestors are to be installed in locations and sized per Manufacturer's installation instructions and the latest edition of the Water Hammer Arrestors Standard PDI WH 201. When a battery of fixtures exceeds 20' in length, then an additional arrestor is required. Contractor to provide a plan showing water hammers locations, size and fixture unit count on each branch line used to size arrestors.**
- F. Install vacuum breakers on all plumbing lines where contamination of domestic water may occur and on boiler make-up lines and hose bibbs.
- G. Provide Reduced Pressure Zone (RPZ) assembly backflow preventor at each piece of equipment including steamers, Combi-Ovens, coffee machines, tea machines, ice machines, etc. Route relief drain to nearest floor sink, floor drain or other code approved disposal point. This must be an indirect connection or have an air gap fitting.
- H. Insulate all exposed water connections for handicapped lavatories and sinks with "Handi Lav-Guard" Insulation Kit (Phone: 203-875-2868).

3.02 TESTING

- A. Test all water piping hydrostatically at 150 psig or 150% of working pressure, whichever is greater, for a period of 24 hours. Observe piping during this period and repair all leaks. Test for lead, certify that lead residual in piping system does not exceed local code requirements.

3.03 STERILIZATION OF DOMESTIC WATER SYSTEMS

- A. Sterilize each unit of completed supply line and distribution system with chlorine solution before acceptance for domestic operation.
- B. Accomplish sterilization as described below or by the system prescribed by the American Water Works Association Standard C-601. Apply the amount of chlorine to provide a dosage of not less than 50 parts per million. Provide chlorine manufactured in conformance to the following standards:
 - 1. Liquid Chlorine: Federal Specification BB-C-120.
 - 2. Hypochlorite: Federal Specification 0-C-114a, Type 11, Grade B or Federal Specification 0-X-602.
- C. Introduce the chlorinating material to the water lines and distribution system after piping system has been thoroughly flushed. After a contact period of not less than 24 hours, flush the system with clean water until the residual chlorine content is not greater than .2 parts per million.
- D. Open and close all valves in the lines being sterilized several times during above chlorination.
- E. The sterilization process shall be done by persons whose major business is water treatment and sterilization. The Plumbing Contractor shall pay all costs and charges associated to this test and certification.
- F. Certify in writing that sterilization has been completed in accordance with these requirements.

END OF SECTION

SECTION 22 11 17 – WATER HEATERS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section describes specific requirements, products and methods of execution relating to the domestic water distribution system for the project.
- B. The work of this section includes: All water distribution work inside the structure, and all outside distribution work up to and including connection to the water source, including provision of the outside water source, or water using apparatus, although the work of this section does include the interface connections at all of these related items.
- C. SPECIAL NOTE: All provisions and divisions of these specifications are a part of this section of these specifications. The Contractor shall consult these divisions and provisions in detail for instructions and include all items pertaining to this work. The Contractor shall consult all other divisions of these specifications, determine the extent of impact on the work required to complete the work required by this section of the specifications or portion thereof and related work shown on the drawings.

PART 2 – PRODUCTS

2.01 GAS WATER HEATER

- A. The water heater shall be a sealed combustion system, taking only outside air for combustion and exhausting the flue gas with PVC Schedule 40 or 80 PVC pipe. Wrap both with material to maintain 25/50 in plenum application. Pipe size to match length requirements.
- B. The heater as well as all related intake air and exhaust intake air and exhaust gas piping shall be approved for zero clearance to any combustible surface.
- C. The heaters tank shall have seamless glass lined steel tank construction with glass lining applied to all water-side surfaces after the tank has been assembled and welded.
- D. Heater to have modulating burner.
- E. All heaters shall run at a combustion efficiency of up to 96% thermal efficiency. Meet the thermal efficiency and standby loss requirements of the U.S. Department of Energy and current edition of ASHRAE/IESNA 90.1. Have foam insulation and a CSA Certified and ASME rated T&P relief valve. Have a down-fired power burner designed for precise mixing of air and gas for optimum efficiency, requiring no special calibration on start-up. Heater shall be supplied with maintenance-free powered anode. All heaters shall be approved in accordance with ANSI Z 21.10.3. All heaters shall be supplied with factory installed low water cutoff, and upper hot water sensor, and lower cold-water sensor. All heaters shall be furnished with a factory installed condensate trap assembly ready for easy connection to a field supplied condensate drain.
- F. Provide acid neutralizing kit to be installed in flue/exhaust condensate line prior to discharging into floor drain or floor sink. Piping from exhaust to acid neutralizing kit must be plastic per manufacturer's installation instructions.
- G. The control shall be an integrated solid-state temperature and ignition control device with integral diagnostics, graphic user interface, fault history display, and shall have digital temperature readout.

- H. The BTH-120-250 models are design-certified by CSA International, according to ANSI Z21.10.3-CSA 4.3 standards governing storage-type water heaters. The BTH-300-500 models are design-certified by Underwriter's Laboratories (UL), Inc. according to ANSI Z21.10.3-CSA 4.3 standards governing storage-type water heaters.
- I. Meet the thermal efficiency and standby loss requirements of the U.S. Department of Energy and current edition ASHRAE/IESNA 90.1. Complies with SCAQMD Rule 1146.2 and other air quality management Owners with similar requirements for low NOx emissions.
- J. The heater shall be factory assembled; test fired for correct BTU input and adjusted for proper combustion parameters. Complete operating and installation instructions shall be furnished with every heater as packaged by the manufacturer with the heater for shipping.
- K. Three-year limited warranty on tank with one year on all other parts.
- L. Manufacturer: A.O. Smith Cyclone MXiBTH Series, Lochnivar Shield or equal by State or Rheem.

2.02 WATER HEATER

A. Electric Water Heater:

1. Pre-wired, factory tested, NSF certified and with UL seal of approval.
2. Tank: Glass lined and ASME approved for 150 psi working pressure with a minimum of 2" of high-density foam insulation; Anode rods for electrolytic protection and hand hole inspection port. Anode rods are to be made from material that is recommended for local water.
3. Thermostats are to be of the immersion type; one thermostat per each set of 3 elements.
4. The complete system to be protected by energy cut off switch in the event of an over temperature situation.
5. Manufacturer: State, PVI, A.O. Smith, Rheem or approved equal.

2.03 Provide an ASME rated temperature and pressure relief valve with drain piping to the nearest drain receptor for all water heaters. The temperature and pressure relief valve shall be labeled and shall be tested in accordance with ANSI Z21.22.

2.04 Provide heat traps on incoming and discharge lines from water heaters that do not come with factory installed heat traps or are not connected to a recirculation system.

END OF SECTION

SECTION 22 13 16 - LIQUID WASTE TRANSFER

PART 1 – GENERAL

1.01 DESCRIPTION

A. Description:

1. This section describes specific requirements, products, and methods of execution relating to the transfer of liquid waste for the project. The work of this section includes providing the following:

a. All liquid waste piping and fittings:

- 1) Soil
- 2) Rain leaders
- 3) Building sewer

b. All plumbing vents, including their termination.

c. All connections at points of collection or handling:

- 1) At plumbing fixtures and trims
- 2) At equipment by others

B. **SPECIAL NOTE:** All provisions and divisions of these specifications are a part of this section of these specifications. The Contractor shall consult these divisions and provisions in detail for instructions and include all items pertaining to this work. The Contractor shall consult all other divisions of these specifications, determine the extent of impact on the work required to complete the work required by this section of the specifications or portion thereof and related work shown on the drawings.

C. All materials exposed within a plenum shall be noncombustible or shall have a flame spread index of not more than 25 and a smoke developed index of not more than 50 when tested in accordance with ASTM E 84.

PLENUM RETURN: PVC OR CPVC CAN NOT BE USED IN PLENUM SPACES IN LIEU OF CAST IRON, IT WILL NOT MEET 25/50 REQUIREMENTS.

DEFAULT DELETE THIS, ONLY USE IF CUSTOMER REQUEST: IF PVC OR CPVC IS USED IN PLENUM SPACES IN LIEU OF CAST IRON, THEN PIPING MUST BE WRAPPED WITH CODE APPROVED INSULATION TO PROTECT PIPING AND MEET 25/50 REQUIREMENTS.

D. All waste, vent, sewer and storm lines shall be of cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International as well as conform to the requirements of CISPI Standard 301, ASTM A-888 or ASTM A-74 for all pipe and fittings, and be manufactured by Charlotte, Tyler, or AB&I.

E. All pipe and fittings shall be manufactured in the United States.

- F. A complete waste and vent system will be provided to collect sanitary waste from all plumbing fixtures, floor drains, and any other equipment, in accordance with the Plumbing Code. In the event piping is not shown to a plumbing device connect waste and vent piping per "Plumbing Fixture Connection Schedule" and route waste and vent to nearest main.
 - G. Grade all horizontal runs of pipe in building and under floor slab at 1/4" per foot downward in direction of flow. If it is absolutely impossible to maintain a grade of 1/4" per foot, piping four (4) inches in diameter and larger may slope to a minimum grade of not less than 1/8" per foot.
 - H. The building will have sanitary sewer lines discharging to the site sanitary sewer system.
 - I. Floor and wall cleanouts will be strategically placed to avoid being located in sensitive areas.
 - J. Floor drains will be provided for each air handling device, equipment requiring drains, toilet rooms with water closets, and mechanical equipment rooms. A floor sink will be provided at each emergency shower unit. Floor sinks and floor drains to be provided in kitchens at ALL locations indicated by Kitchen drawings.
 - K. Each floor drain/sink will be provided with a p-trap and a trap primer.
- 1.02 CONNECTION TO UTILITY SEWER AND STORM DRAIN SYSTEMS (storm drain piping is considered to be piping beyond 5'-0" outside the building)
- A. Final wastewater connection point to extend approximately five feet (5') outside the building, as indicated on the drawings. Coordinate with Civil Drawings for wastewater service point to within five feet (5') of the building. **Coordinate with site utilities to insure proper inverts for all lines and connection point prior to installation.** Contact Architect immediately if any conflict is discovered. Make final connection to service line. Obtain all permits, pay fees and provide all services incidental to this work.
 - B. When No Civil Engineer: Coordinate with site utilities to properly locate the sewer and make the connection in accordance with approved practices. Obtain all permits, pay fees, and provide all services incidental to this work. **Coordinate with site utilities to insure proper inverts for all lines and connection point prior to installation.** Contact Architect immediately if any conflict is discovered. Make final connection to service line.

PART 2 – PRODUCTS

- 2.01 SEWER PIPE UNDERGROUND INSIDE STRUCTURE (INCLUDES TO FIVE FEET FROM BUILDING PERIMETER)
- A. Base Bid: Service weight cast iron soil pipe with Tyseal neoprene gaskets.
 - 1. Epoxy coated Service Weight cast iron soil pipe to be bid as an additive or deductive alternate.
 - B. Schedule 40 solid core PVC (DWV pipe and fittings) as allowed by code. Material Data: Type 1, Grade 1 PVC 12454-B, ASTM D-1784.
 - C. Pipe 1-1/2" and Smaller: Schedule 40 galvanized steel pipe with cast iron drainage fittings.

- D. High Temperature Wastewater: Waste line piping and fittings serving floor sink for commercial dishwasher and floor trough for tilt/braising pan in kitchen and associated main to be service weight cast iron soil pipe with Tyseal neoprene gaskets, to a point twenty feet (20') downstream of dishwasher. Remainder of grease system in kitchen may be PVC as listed in 2 above.

2.02 RAINLEADERS BELOW SLAB AND ABOVE GROUND INSIDE STRUCTURE

- A. Cast iron soil pipe with heavy weight no-hub fittings. (ALL rain leader bodies, piping horizontal and vertical must be insulated.)
- B. **Underground RAINLEADER piping: Cast iron soil pipe. Use stainless steel couplings (28-gauge, Type 304SS) with neoprene gasket meeting ASTM Standard C-564 meeting FM 1680, Class 1. Husky SD 4000, Clamp-All 80 lb. or equal.**

2.03 SEWER ABOVE GROUND INSIDE STRUCTURE

- A. Service weight cast iron soil pipe with tyseal neoprene gaskets or cast-iron soil pipe with no-hub fittings. Reference 2.05 below.
- B. **DEFAULT DELETE THIS, ONLY USE IF CUSTOMER REQUEST: Value Savings Option: Schedule 40 solid core PVC (DWV) as allowed by code. Material Data: Type 1, Grade PVC 1120, ASTM D-1784. Verify if area is used as plenum which requires 25/50 rating.**

2.04 VENTS

- A. All vent piping above slab to be cast iron soil pipe with tyseal neoprene gaskets or no-hub fittings.
- B. All vent piping under slab to be heavy weight no-hub fittings.
- C. DWV copper with wrought or cast solder fittings.
- D. **DEFAULT DELETE THIS, ONLY USE IF CUSTOMER REQUEST: Value Savings Option: Schedule 40 solid core PVC (DWV) as allowed by code. Material Data: Type 1, Grade PVC 1120, ASTM D-1784. Verify if area is used as plenum which requires 25/50 rating.**

2.05 CAST IRON PIPE/FITTINGS

- A. Tyseal Gaskets or MG Couplings.
- B. Hubless couplings shall be composed of a stainless-steel shield, clamp assembly and an elastomeric sealing sleeve conforming to the most current edition of CISPI 310, listed by NSF International, manufactured in the United States of America, and manufactured by Anaco, Mission, Tyler or Ideal. Provide minimum 80LB torque standard couplings for standard fittings inside structure above slab and heavy-duty couplings with double bands rated for 120LB torque for all below slab and underground piping.

2.06 CONDENSATE AND ALL MISCELLANEOUS DRAIN PIPING

- A. Type L or M: Hard drawn copper.
- B. Value Savings Option: Schedule 40 solid core PVC.

2.07 ACID WASTE/VENT PIPING

A. Pipe and Fittings

1. Below Ground Waste
 - a. Minimum schedule 40 CPVC piping system with solvent cement joints: Spears "Lab Waste" or Charlotte "Chemdrain".
 - b. Minimum Schedule 40 Polypropylene or PVDF with electrofusion joints by R & G Sloan, GSR Fuse Seal, Orion or IPEX Enfield.
2. Above Ground Waste and Vent (Must be plenum rated)
 - a. Minimum Schedule 40 CPVC (must be wrapped with insulation to meet 25/50 plenum rating) piping system with solvent cement joints: Spears "Lab Waste" or Charlotte "Chemdrain".
 - b. Minimum Schedule 40 Polypropylene or PVDF with electrofusion or mechanical joints by Orion PVDF, IPEX "Labline".
3. Above and below ground systems to be compatible.
4. All piping system components open to plenum to meet UL or ULC 25/50 requirements.
5. No mechanical joints allowed under slab.
6. All fused joints to be made with manufacturer's recommended power block for fuse seal type piping.

B. ACID NEUTRALIZATION TANK

1. High density polyethylene tank conforming to ASTM D1248. Tank to be provided with FRP fiberglass wrapping and vent located on side of tank above inlet and outlet piping.
2. All fittings made of polyethylene and welded into all penetrations.
3. Acid dilution tank manufacturer to provide factory installed extension ring to bring top of acid dilution tank to within 3" of bottom of traffic bearing lid of supplied concrete pit. Extension ring to be same diameter as tank.
4. Manufacturer to provide full sized reinforced fiberglass circular top with manhole cleanout cap.
5. Install and fill per manufacturer's directions. Provide manufacturer's installation instructions with submittal.
6. Minimum acid neutralization tank sizes to be as follows: Up to 16 stations use a 55 gallon, 17 to 25 stations use a 100 gallon and 26 to 42 stations use a 150 gallon.
7. Provide reinforced concrete pit (diameter as required) for acid neutralization tank. Provide with openings as required for piping connections to tank and traffic bearing lid. Provide height as required by field conditions to bring top up to finished grade level.
8. Provide with limestone chip fill as required.

9. Manufacturer: Park or Equal.

2.08 EXPANSIVE SOIL – CIVIL CONNECTIONS

- A. Provide Flexible Expansion Joints: "EBAA IRON INC", FLEX-TEND, EXTEND, PVC, DUCTILE IRON.
- B. Reference 'EXPANSIVE SOIL PLUMBING GENERAL NOTES' on plans.

PART 3 – EXECUTION

3.01 INSTALLATION OF UNDERGROUND PIPING

- A. Install pipe and fittings to required grade with hubs and bottom half section in undisturbed soil. Follow manufacturer's installation requirements.

3.02 INSTALLATION OF ABOVE GROUND PIPING

- A. Refer to Section 20 01 00.

3.03 GRADING

- A. Grade all horizontal runs of pipe in building and under floor slab at 1/4" per foot downward in direction of flow. If it is absolutely impossible to maintain a grade of 1/4" per foot, piping four (4) inches in diameter and larger may slope to a minimum grade of not less than 1/8" per foot.

3.04 SUPPORTING

- A. Support all horizontal runs of pipe in building at intervals not to exceed 5'-0" and at each change of direction. Provide a support at the base of vertical risers with intermediate supports as required. Brace all adequately to prevent motion, per manufacturer's recommendation. Reference Section 20 01 00, 2.08, B., Mechanical Support Devices and Pipe Supports for further requirements.

3.05 CLEANOUTS

- A. Provide cleanouts as shown on plans and in an accessible location at base of all risers in soil, waste and drain piping and at each change in direction in horizontal runs of pipe. In long straight runs, provide a cleanout located at intervals of not more than 75 feet for piping four inches (4") and larger and located at intervals of not more than 50 feet for piping less than four inches (4").
- B. Cleanouts shall be located no closer than 24" to a wall.
- C. For each urinal a cleanout shall be installed above the fixture connection fitting. Coordinate exact location with Architect.

3.06 VENTING

- A. Provide a vent for each trap, plumbing fixture and waste line required per code.
- B. Extend each vent vertically to a point not less than six inches (6") above the extreme overflow level of the fixture served before offsetting horizontally. Whenever two or more vent pipes converge, extend each such pipe at least six inches (6") in height above the flood rim level of the plumbing fixture it serves before being connected to any other vent and utilize only approved drainage fittings and materials to connect piping.

- C. Provide a building main relief vent for waste piping not provided venting by fixture branch connections. Vent size shall be per code requirement, based upon fixture unit loading in the pipe vented.

3.07 VENTS THROUGH ROOF(VTR)

- A. Provide as many VTR's required for proper venting of plumbing system. VTR's shown on plans are for coordination purposes, and do not represent ALL required VTR's.
- B. Extend vents through the roof a minimum distance of 6" and terminate at least 15 ft. horizontally from operable windows, doors, or air intakes, and at least 3 feet above such opening. Do not terminate vents through roof at edge or valley of roof. Coordinate locations with ALL other trades and sensitive view areas with Architect prior to installation.
- C. Flash and counterflash vents through roof. Provide flashings not less than 18" square, with prefabricated 4-pound lead counterflashing. Extend vertical portion of flashing up entire length of pipe and turn down inside the pipe at least 1 inch with turned edge hammered against pipe. Coordinate with type roof and Architectural details and flash them into roof according to the roofing products manufacturer's recommendations.
- D. Protect the roof from tools and equipment. Remove all scraps on roof to prevent damage to roof.

3.08 GENERAL

- A. No piping shall be permanently concealed before the examination is completed by the authorities having jurisdiction.
- B. All fixtures used in conjunction with the conveying of waste substance shall be connected by means of a trap.
- C. All connections for floor mounted water closets and waste piping shall be made with appropriate closet flange and wax gaskets.
- D. Insulate all exposed p-traps for handicapped lavatories and handicap sinks with "Handi Lav-Guard" Insulation Kit (Phone: 203-875-2868) as required.
- E. Provide specialty shielded transition coupling as required at connections between PVC and cast-iron fitting.
- F. **Horizontal to horizontal connections cannot use double combo, double wye and one eighth or sanitary cross fittings.**

3.09 TESTING

- A. Test all piping in accordance with the requirements of the local codes.
- B. Repair leaks and retest system, repeating this process until piping system is free of leaks.
- C. Test shall be conducted and completed before any joints are concealed or made inaccessible.
- D. Maintain a log of tests indicating date, time, result of test and person doing test.
- E. Under floor
 - 1. Test pipe under floors before connecting to sewers.

2. Maintain not less than 15 feet of hydrostatic head.
3. Repair all leaks and repeat until system holds for 2-hours without a drop in water level.

3.10 CONDENSATE PIPING

- A. Route insulated copper condensate drain line from each unit to nearest floor drain, deep seal traps, sink p-traps, janitor sink, dry well (exterior units), or roof drain if piped to storm sewer (cannot use roof drain if day lites at surface) code approved or disposal point unless otherwise noted. Condensate shall not drain on to roof. Mechanical Contractor and Plumbing Contractor to coordinate locations. Slope all piping to drain at minimum 1/8" per foot. Drains shall be sized in accordance with equipment capacities as follows:

EQUIPMENT CAPACITY	*MINIMUM PIPE SIZE
Up to 3 tons of refrigeration	3/4"
3 to 20 tons of refrigeration	1"
21 to 90 tons of refrigeration	1-1/4"
91 to 125 tons of refrigeration	1-1/2"
126 to 250 tons of refrigeration	2"

*Minimum size of drain shall not be smaller than drain outlet size for unit.

- B. Coordinate mounting heights of units to allow adequate slope for condensate piping to disposal point.
- C. Provide cleanout plug at end of each main run.
- D. All condensate piping to be insulated to prevent condensation. This includes all waste piping above slab or in crawl space that has condensate draining into it. Included P-Traps and Hub Drains.
- E. Drywell (French Drain): The drywell shall consist of a pit not less than 24" in diameter (or 24" x 24") and 24" in depth. The pit shall be filled to within 3" of the finished grade with coarse gravel. Top 3 inches to be filled with topsoil and sodded. Gravel to be wrapped completely (top, sides and bottom) with heavy duty weed block fabric. Install a 3" perforated PVC drainpipe (centered in drywell) with cap at bottom extending to bottom of pit. Install a 3" perforated pipe to extend 3" - 5" above finished grade and mounted offset of the drywell within 2" of the building for final connection of copper condensate lines. Final connection of offset perforated pipe and drywell perforated pipe shall be below finished grade. Refer to details in plans for additional information. Provide appropriately sized bushing or fittings to rigidly tie to condensate drain line from unit. Perforated pipe above grade will act as air brake connection. Twenty-four-inch (24") diameter or 24" x 24" x 24" deep can be used for up to 5-ton capacity. Thirty-six-inch (36") diameter or 36" x 36" x 24" deep can be used for up to 13-ton capacity. Forty-eight (48") inch diameter or 48" x 48" x 24" deep can be used for up to 30-ton capacity. Confirm final requirements with code authority having jurisdiction.

3.11 EXPANSIVE SOIL – CIVIL CONNECTIONS

- A. Reference 'EXPANSIVE SOIL PLUMBING GENERAL NOTES' on plans. If notes are not present submit RFI and request for requirements.

END OF SECTION

SECTION 22 30 00 - PLUMBING FIXTURES AND TRIM

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included:
1. This section describes certain components of domestic plumbing systems, including related specific requirements, products and methods of execution. Plumbing water, waste, vent piping and other primary distribution components of the plumbing system are included with related work specified elsewhere.
- B. SPECIAL NOTE: All provisions and divisions of these specifications are a part of this section of these specifications. The Contractor shall consult these divisions and provisions in detail for instructions and include all items pertaining to this work. The Contractor shall consult all other divisions of these specifications, determine the extent of impact on the work required to complete the work required by this section of the specifications or portion thereof and related work shown on the drawings.

PART 2 - PRODUCTS

2.01 FLOOR DRAINS

- A. All floor drains, including floor sinks, are to be the same size as the waste line size indicated on plans. If size is not indicated, drain size shall be 3". Top of floor drains and floor sinks to be square and to be flush with finished floor. Floor drains that tie into acid waste piping are to have acid resistant coating or be stainless steel. Floor Drains and Floor Sinks in kitchen areas are to have Acid Resistant Enamel coating or be constructed from stainless steel.
- B. **Floor Drain: Trap Seal Protection: All floor drains, floor sinks and hub drains must have Trap Primers and Trap Guards.** Primary method of trap priming required by documents is the inverted tee connection (Jay R Smith Prime-EZE or equal) from sink tailpiece or flush valve type connection for trap priming with gray water. Prior to using any other trap priming method, contractor must submit RFI and Shop Drawing, detailing why inverted tee method cannot be used, and indicate ALL locations being requested for Alternate compliance. If Approved in writing (prior to any installation) by Owner/Engineer, the last resort for alternate compliance will be electronic trap primer (Manufacturer: Sioux Chief 695-ES01 or equal as required), connected to nearest water serving that area per manufacturer's installation instructions. Provide minimum 12 x 12 stainless steel access door or larger as required. Coordinate 120volt power and disconnect requirements with electrical contractor. **In addition to Trap Primer, also provide Proset "TRAP GUARD" or equivalent device for ALL floor drains, floor sinks and hub drains.**
- C. **Provide both Trap Guards and Trap Primers for ALL floor drains, floor sinks and HUB drains.**
- D. Trap primers must conform to ASSE 1018 or ASSE 1044 (Pflugerville allows only ASSE 1044).
- E. Trap Primer Manufacturers: Sioux Chief, MIFAB, Precision Plumbing Products, Jay R Smith, Sloan, Zurn, Wade or Watts.
- F. Floor Drain/Floor Sink Manufacturers: StainlessDrains, Kessel, MIFAB, Josam, Wade, Zurn or Jay.R. Smith, Watts.

2.02 ROOF DRAINS

- A. Provide 30" square, four-pound lead flashing for all roof drains, centered around drain. Coordinate with type roof and Architectural Roof Plan and Architectural details. Roof drains to be installed in low point of roof. Verify low point in roof before installation. Roof drains to be moved at no additional cost to owner if not coordinated and installed in low point of roof to allow for proper drainage.
- B. Where horizontal offset is not possible directly below drain connection, install an expansion joint directly under the drain. MIFAB R1900 Series.
- C. All roof drains shall be same size as the rainleader piping size serving roof drain as indicated on the drawings.
- D. Roof Drains:
 - 1. RD1 Primary roof drain, cast iron body, flashing collar, gravel stop, ductile iron dome, under deck clamp, extension and sump receiver. MIFAB R1200-M-E-U Series.
 - 2. RD2 Overflow roof drain same as RD-1, set inlet 2 inches higher than inlet of RD-1. MIFAB R1200-M-E-U-W. Coordinate and confirm final location with roofing consultant prior to rough-in.
- E. Manufacturers: StainlessDrains, MIFAB, J.R. Smith, Zurn, Josam, Wade, Watts or approved equal.

2.03 CLEANOUTS

- A. Cleanouts shall be same nominal size of pipelines up to four inches (4") and not less than four inches (4") for larger lines.
- B. Floor Cleanouts: Gas and watertight seal, internal taper ABS cleanout plug, stainless steel or nickel bronze finish, scoriated square top with countersunk screw for installation flush with finish floor. MIFAB C1100R-3 Series. If floor has a waterproof membrane, then add C clamp ring flange.
- C. Wall Cleanouts: MIFAB C1400-RD Series. Countersunk plugs, with smooth round access cover and polished stainless steel or nickel bronze finish.
- D. Manufacturers: StainlessDrains, MIFAB, Josam, Zurn, Wade, Watts or approved equal.
- E. Cleanouts that tie into acid waste piping to be acid resistant.

2.04 FIXTURES

- A. Manufacturers:
 - 1. The fixtures are chosen from standard manufacturers.
 - 2. Provide all similar fixtures and trim from one (1) manufacturer, except where specified otherwise.
 - 3. Equality: The following manufacturers are considered equal, specified item(s) sets minimum standard for acceptability.

- a. **Fixtures:** American Standard, Eljer, Kohler, Elkay, Fiat, Sloan, Toto, Zurn.
 - 1) All water closet bowls shall have fully glazed trap.
 - 2) All water closet bowls must meet MAP Testing (Maxim Performance Testing) at 1000 grams.
 - b. **Faucets:** American Standard, Bradley, Elkay, Chicago, Sloan, Zurn, T & S Brass, Moen Commercial. **Must have five (5) year Commercial Warranty. PROVIDE CONFIRMATION OF WARRANTY IN SUBMITTAL.**
 - c. **Stainless Steel Sinks:** Elkay, Bradley, Moen or Just.
 - d. **Carriers:** MIFAB, J.R. Smith, Josam, Watts or Zurn.
 - e. **Flush Valves:** Sloan Royal or equal by Zurn
 - f. **Point of Use ASSE 1070 Lead Free Mixing Valves:** Watts, Powers, Bradley, Leonard, Lawler, Symmons or Moen.
 - g. **Drinking Fountains/Electric Water Coolers:** Elkay, Acorn Aqua Surf, Oasis or Halsey Taylor, must meet NSF Section 9 in its entirety and meet TCEQ Certification Requirements. Provide letter with submittal data.
 - h. **Wash Fountains:** Bradley, Zurn, Wiloughby or Sloan Stone.
 - i. **Wall Pipe Supports:** HoldRite or Equal
 - j. **Acrylic Showers:** Lasco, Aquabath
 - k. **Circulating Pumps:** Taco, Grundfos, Armstrong, Wilo
 - l. **Stainless Steel Skullery Sinks:** Elkay, Bradley, Just, Advance Tabco, Griffin.
 - m. Provide wall carriers for ALL wall-mounted fixtures, including wash fountains.
- B. Traps, Stops and Supplies:
1. Provide traps, stops and supplies for all fixtures.
 2. P-Traps and Tail Pieces: 17-gauge chrome-plated cast brass. Provide offset type as required to meet ADA space requirements.
 3. Supplies: Flexible, chrome-plated, 7538 Series.
 4. Stops: Quarter (1/4) turn removable key type, 2302 Series.
 5. Supplies and stops are to meet current requirements of NSF61.
 6. Manufacturers: American Standard, Brass Craft, McGuire or equal.
- C. Fixtures Specified Elsewhere, or Otherwise Furnished. Provide appropriate strainer, tailpiece, trap, waste and supplies. Rough-in and connect only.

- D. Faucets:
1. All faucets except commercial kitchen and bar sinks are to meet ANSI/NSF Standard 61 and be listed by NSF as residential drinking water faucets.
 2. All faucets not NSF 61 listed, (as described in paragraph 1) must have tin lined waterways or other such material so water flowing through the faucet is not in contact with any material that could allow "Leaching" of lead into the waterway.
 3. Commercial kitchen and bar sinks are to meet ANSI/NSF Standard 61 and be listed as commercial faucets. Faucets meeting the stricter residential standards can be used at contractor's option.
 4. Faucets are not allowed to have more than the maximum total lead content as listed by NSF, TCEQ (Health and Safety Code) and EPA.
 5. Any faucets which exceed lead concentration "Leaching" into water stream after a minimum of 45 days usage and proper flushing prior to testing shall be replaced by the manufacturer with an acceptable product. All costs of change out incurred will be sole responsibility of the manufacturer.
 6. Lavatory faucets to have .5 GPM vandal resistant aerator.
- E. Waterways and tanks for all drinking fountains and water coolers shall be constructed of 3. lead-free (0.00% lead) materials. All waterways to be totally free of lead. No lead solder is permitted. All drinking fountains and water coolers to meet latest criteria of TCEQ, EPA and be listed by NSF.
- F. All water line, fittings and fixtures in contact with potable water to be "lead free" AB1953 compliant (.25% or less average lead content). All submittals to state items comply in submittal package.

2.05 FIXTURE FLOW RATES

- A. The maximum flow rates for plumbing fixtures are to be no greater than quantities listed below or the maximum applicable code or ordinance allowed flow rate, whichever is less:
1. Toilets – 1.28 gallons per flush (GPF) on all projects.
 2. Urinals – 0.125 gallons per flush (GPF) on all projects
 3. Lavatory (hand sink) – 0.5 gallons per minute (GPM) on all projects
 4. Shower – 2.0 gallons per minute (GPM) on all projects

PART 3 - EXECUTION

- 3.01 Store all fixtures and trim above ground in a covered location not subject to accidental damage by traffic or other construction activities. Handle fixtures and trim carefully to avoid chipping, denting, scratching, or other damage. Replace damaged items with same item in new condition.
- 3.02 Provide permanent metal and wire positioners, supports and fixture carriers to secure fixtures and piping rigidly in proper alignment without sway or side play.
- 3.03 Anchor all fixtures securely to withstand applied vertical load of not less than 250 pounds on the front of the fixture, without noticeable movement.

- 3.04 Install all fixtures plumb, level and flush to the finished Architectural surface, so that the maximum gap between the fixture and the surface does not exceed 3/16 inch. **Grout** under water closets to level fixtures. Caulk the edge of the joint between fixture and surface with silicone or butyl type waterproof caulking compound.
- 3.05 Adjust all functional components for proper operation in accordance with manufacturer's recommendations, or as otherwise directed.
- 3.06 Clean all fixtures and trim thoroughly to a spotlessly clean condition. Obtain a written certification from the Architect that this has been accomplished.
- 3.07 Where floor drains or janitor sinks are located over any room, provide waterproof installation.
- 3.08 Ensure final location of cleanouts have access and ample clearance at cleanout for rodding of drainage system. Check locations before installation. Contact Architect for alternate location if maintenance clearance is a problem. Cleanouts to be moved at no additional cost to Owner for failure to coordinate locations.
- 3.09 Coordinate slope of floors to floor drains with Architect. Adjust height of floor drain for proper drainage.
- 3.10 Provide all adapters, flanges, gaskets, etc. as required for proper installation of fixtures. Coordinate fixture placement before core drilling of floor or sleeve installation.
- 3.11 Insulate all exposed p-traps and water connections for handicapped lavatories with White Dearborn Brass ADA100 resealable foam Insulation Kit or equal. Kit to fit straight or offset drain as required.
- 3.12 **No offset flanges will be allowed for installation of water closets.**
- 3.13 Install all trap priming devices per manufacturer's installation instructions. Provide shut-off valves at each mechanical or electronic trap primer for service. Install minimum 12" x 12" access doors as required for service of trap priming devices.
- 3.14 Provide a floor sink with trap priming device in each sprinkler riser room.
- 3.15 Provide waste, cold water, hot water, and vent piping to ALL plumbing fixtures as described in Plumbing "Fixture Connection Schedule" and in any kitchen drawings by others.
- 3.16 **Cleanout locations:**
- A. **On each horizontal drain line 5 feet or greater in length.**
 - B. **No more than 50 feet on center.**
 - C. **At changes in director of 90 degrees or more (line size).**
 - D. **At the end of each continuous waste line.**
 - E. **At the end of each battery of fixtures.**
 - F. **At each sink and urinal.**
 - G. **Additional areas required for service and by code.**

END OF SECTION

SECTION 23 05 93 – TEST AND BALANCE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The section describes general requirements and methods of execution relating to the testing and balancing of the mechanical systems provided on this project. Plans and specifications are complimentary. Carefully look at both.
- B. Scope:
 - 1. Furnish the services of a qualified and approved Testing and Balancing Agency to perform the work of this specification.
 - 2. The work of this section includes, but is not necessarily limited to:
 - a. Testing and balancing all fans, all air handling systems, all energy recovery ventilators and makeup air systems.
 - b. Providing a final report. Final report to be submitted for review only after all deficiencies have been corrected and design CFM's are achieved.
 - 3. Commissioning Requirements:
 - a. Contractor required to show compliance with code required and Owner required commissioning scope.
 - b. Contractor to obtain a Fieldwire Pro software license or other software license required by Commissioning Agent for the duration of the project commissioning.
- C. SPECIAL NOTE: All provisions and divisions of these specifications are a part of this section of these specifications. The Contractor shall consult these divisions and provisions in detail for instructions and include all items pertaining to this work. The Contractor shall consult all other divisions of these specifications, determine the extent of impact on the work required to complete the work required by this section of the specifications or portion thereof and related work shown on the drawings.

1.02 APPLICABLE STANDARDS

- A. SMACNA Manual for the Balancing and Adjustment of Air Distribution Systems.
- B. AMCA Publication 203, Field Performance Measurements.
- C. AMCA Standard 300-67, Test Code for Sound Rating.
- D. National Environmental Balancing Bureau (NEBB) Recommended Procedures.
- E. National Balancing Council (NBC)

1.03 PRE-QUALIFIED AGENCY

- A. Subcontractor Minimum Qualifications Include:

1. Maintain a complete service organization that has operated within a one hundred (100) mile radius of the project for at least three years prior to bid date of this project.
 2. Demonstrate satisfactory completion of three projects of similar size and scope. Provide references if requested.
- B. Bids by suppliers, Contractors or any firm not listed in #5 below are not acceptable.
- C. Independent, NEBB or TABB certified agency with no affiliation to mechanical contractor.
- D. Pre-qualified T & B Agencies are as follows:
1. Fluid Balance (512)826-8234
 2. Complete System Balance – (972-965-4289)
 3. PHI (512)339-4757.
 4. CenTex Air Balance Inc (254)913-3132.
 5. Air Technologies (512)280-3398.
 6. Additional Owner Approved T&B firms bid as an alternate and submit forms.

1.04 TIMING OF WORK

- A. Do not begin testing and balancing until the systems are completed and in full working order.
- B. Schedule the testing and balancing work in cooperation with other trades.
- C. Complete the testing and balancing before the date of final project completion.

1.05 MECHANICAL CONTRACTOR RESPONSIBILITY TO BALANCING AGENCY

- A. Award the test and balance contract to the approved agency upon receipt of contract to allow the Balance and Testing Agency to schedule this work in cooperation with other trades involved and comply with completion date.
- B. Put all heating, ventilating, and air conditioning systems, equipment and controls into full operation for the Balancing Agency and continue the operation of same during each working day of testing and balancing.
- C. Provide scaffolding, ladders and access to each system for proper testing and balancing.
- D. Provide and change pulleys, belts and dampers, add any dampers and correct any installation errors in a timely matter as required for correct balance as recommended by the Balance and Testing Agency or as directed by the Architect after review of Balancing Report, at no additional cost to the Owner.
- E. Fix ALL deficiencies noted in T&B report prior to submitting report to Engineer.

PART 2 - PRODUCTS

2.01 THIS PART NOT USED.

PART 3 - EXECUTION

3.01 INSTRUMENTS

- A. Maintain all instruments accurately calibrated and in good working order. Use instruments with the following minimum performance characteristics.
- B. Air Velocity Instruments: Direct reading in feet per minute, 2% accuracy.
- C. Static Pressure Instruments: Direct reading in inches water gauge, 2% accuracy.
- D. RPM Instruments: Direct reading in revolutions per minute, 1/2% accuracy; or revolution counter accurate within 2 counts per 1000.
- E. Temperature Readout: Direct reading in degrees F., plus minus 0.1 degrees F.

3.02 GENERAL PROCEDURES FOR ALL SYSTEMS

- A. In cooperation with the Contractor's representative, coordinate adjustments of automatically operated dampers and valves, including the controlling thermostats, to operate as specified, indicated, and/or noted.
- B. Use manufacturer's ratings on all equipment to make required calculations.
- C. MAKE FINAL ADJUSTMENTS FOR EACH SPACE PER HEATING OR COOLING COMFORT REQUIREMENT. State reason for variance from design cfm, i.e., "too noisy", "too drafty", etc.
- D. Balancing to occur with clean filters when applicable and wet coils when applicable.

3.03 REQUIREMENTS FOR ALL AIR HANDLING SYSTEMS

- A. Identify each diffuser, grille, and register as to specific location and area.
- B. Identify and list size, type and manufacturer of diffusers, grilles, registers and all equipment tested.
- C. In readings and tests of diffusers, grilles and registers, include required fpm velocity and required cfm and test cfm after adjustments. If test apparatus is designed to read cfm directly, velocity readings may be omitted. Identify test apparatus used. Identify wide open (W.O.) runs.
- D. Adjust all diffusers, grilles and registers to minimize drafts and excess noise in all areas.
- E. **Before any Test and Balance work begins, the Test and Balance Contractor shall insure that there is an adequate return air path above the ceiling (plenum) for all systems. This includes makeup air for exhaust fan, ERV's, etc. The maximum velocity (FPM) through opening/ducts not to exceed 800 FPM. Test and Balance Contractor to verify that all plastic covering transfer openings have been removed. Provide a written report to Engineer that all systems have adequate return air/makeup air pathways prior to starting any work. When all of the pathways have been established testing and balancing may begin.**

3.04 BALANCING LOW VELOCITY DUCTWORK

- A. **After adjusting blower to lowest overall point possible, adjust the branch dampers so that each stale air exhaust inlet or outside air supply outlet in the system is to + or - 5% of design airflow on all makeup air units and energy recovery ventilators.**

- B. All other HVAC systems on the project are to be adjusted as per 'A' above except to + or - 10% of design airflow per air device outlet. Air device outlet deviation higher than + or - 10% is not acceptable, even if total unit deviation is within tolerance. **However, DX comfort cooling units are to be balanced to never exceed 400 cfm/ton or be less than 300 cfm/ton on highest stage. Notify engineer if plans deviate from this CFM range for guidance. 5 ton units must be balanced to provide under 2000 CFM. Use CFM shown at air devices, *not* nominal CFM shown on equipment schedule. See Standard Notes on RTU Master Schedule. For units with 2-stage scroll compressors on low stage cooling, set units to provide approximately 66% of high stage cooling CFM and discharge air in cooling should be at or below 56°F or CFM should be lowered until achieved.**
- C. **Adjust the fan for design airflow on constant volume systems. Adjust fan for highest stage airflow on all systems with varying airflow, with fan and compressor on highest stage. On multistage units requiring it, set up fan to match all lower stages of cooling as required. If unit is set up incorrectly with T&B done for high stage with unit only asking for lower stage compressor stage, unit will not dehumidify and balance will have to be redone at no additional cost. Verify proper procedures with equipment manufacturer and engineer.**
1. Record Discharge Air Temp in High and Low speed Cooling
 - a. If unit has additional cooling speeds record Discharge Air Temp in all cooling speeds.
 2. Record Discharge Air Temp in High and Low speed Heating
 3. For variable speed units that control to discharge air temperature, set discharge at temperature for cooling to 54 degrees.
- D. Read and record the airflow at each return or exhaust inlet and each supply outlet. Balance as required on constant volume and/or highest stage.
- E. Secure each branch damper and mark the balanced position of the damper quadrant.
- F. Adjust fan for each stage of airflow (to match compressor staging) on all systems with varying airflow. Discharge air for all stages should be 56°F or lower in cooling.
- G. Read and record the airflow at each supply outlet in high and lowest stages. On infinite variable flow blowers on units with variable speed compressors measure and record airflow at lowest stage of compressor loading.
- H. 2 to 6 ton units are generally 2 stage with compressor capacity of either 66% of rated tonnage on low stage or 100% of capacity on high stage. For these units air device CFM is used for high stage operation and low stage CFM is to be set for approximately 66% of listed air device CFM. Some manufacturers have built in logic to drop fan speed to match cooling stage and some require it to be set manually.
- I. For larger units with multiple compressors, set blower CFM to match capacity of operational stage(s) of cooling. Confirm capacities and required CFM setting procedures for blower with equipment supplier. Default is 66% of high stage cooling when there are two stages of cooling. Discharge air for all stages should be 56°F or lower in cooling.
- J. For chilled water AHU's set airflow on high to match air device CFM shown. Read sequence of operation. If blower CFM is integrated to chilled/hot water valve opening position, also record lowest blower CFM setting allowed (usually about 35% of air device CFM shown).

3.05 FAN ADJUSTMENT

- A. Balance ductwork before making final fan adjustment for highest stage or constant volume.
- B. Verify that system is free of debris and that inlets and discharges are not obstructed and that filters are clean.
- C. Make pitot traverse of main ductwork to determine total airflow and record.
- D. Adjust fan rpm to obtain design airflow.
- E. Test and record motor amperage and voltage on each phase leg. Reduce fan rpm if necessary, so that motor running amperage does not exceed motor nameplate amperage. Record final amperage and voltage.
- F. Record fan rpm.
- G. Test and record system (suction) return and (discharge) supply static pressures on highest CFM.
- H. Record airflow. Record total Airflow in all speeds High / Medium / Low or High / Low depending on unit design.
- I. Test and adjust system for minimum design cfm outside air (intake and exhaust), as shown, where applicable.
- J. **Test and record entering air temperatures across coils and fans on highest and on lowest stages of cooling/heating.**
- K. **Test and record leaving air temperatures (heating and cooling) across coils.**
 - 1. Record Discharge Air Temp in High and Low speed Cooling
 - 2. Record Discharge Air Temp in High and Low speed Heating
 - 3. For variable speed units that control to discharge air temperature, set discharge at temperature for cooling to 54 degrees.
- L. **Make-Up/Outside Air Machines: Test and record entering air temperature and humidity plus discharge air temperatures and humidity delivered to space on all makeup air/outside air units in cooling mode. CFM to be set minimum to specified CFM up to 5% over on Airflow Monitoring Station. CFM should not be under design.**
- M. Test and record static pressure drop across each filter and coil bank on highest stage.
- N. Provide test data for each AHU, FCU, RTU, MAU, ERV, EF, SF, ETC., used on project:
- O. Test and document operation of each MAU, RTU, AHU, CU, HP and FAN in all modes of operation and in all stages of operation. Insure that all pieces of HVAC equipment are functioning properly and are properly connected to the control system. **Check and document inlet and outlet temperatures in all stages of cooling, heating, reheat and emergency heating modes, if unit is so equipped.**

3.06 BALANCING REPORT

- A. Compile the test data and submit PDF of the complete test data for forwarding to the Architect for acceptance and/or analysis and recommendations. Report must be complete, and ALL deficiencies corrected prior to submittal to architect.
- B. Include a complete list of all test equipment used, including apparatus manufacturer's name, model number, serial number and date last calibrated.
- C. Include complete identification of all elements. Identify by unit number, room name and number, air outlet symbol, etc., to clearly and positively identify the location of each element.
- D. Include all test data specified in addition to test data recommended in the applicable standards referenced in Part 1. Tabulate all nameplate data at all balanced equipment and at the associated motors.
- E. Tabulate data separately for each system. Describe balancing method used for each system.
- F. Include at the front of the report a summary of problems encountered, deviations from design, resolution of problems, recommendations and comments.
- G. For Multi-Speed/Stage units provide and record Discharge Air Temps at ALL stages.
 - 1. Record Discharge Air Temp in High and Low speed Cooling (if discharge air is above 56 degrees, contact mechanical contractor and coordinate remedy)
 - 2. Record Discharge Air Temp in High and Low speed Heating
 - 3. For variable speed units that control to discharge air temperature, set discharge at temperature for cooling to 54 degrees.
- H. Reports missing the following will be rejected and resubmitted. Commissioning will not begin until all of the following have been completed for all Cooling and Outside Air Machines.
 - 1. Discharge Air in Cooling – for High and Low Speed
 - 2. Discharge Air in Cooling with Outside Air Damper open – in High and Low Speed.
 - 3. Discharge Air in Dehumidification mode, when equipped.
 - 4. Discharge Air in Cooling above 56 degrees in any stage of cooling. Must be addressed with Mechanical Contractor.

3.07 Reference "Start-Up Report Verification" in the General Provisions Specification.

END OF SECTION

SECTION 23 08 02 - EQUIPMENT START-UP

PART 1 - GENERAL

1.01 DESCRIPTION

A. Description

1. **This section describes specific requirements and methods of execution which relate to the Start-up of the mechanical installation by the factory/vendor, mechanical contractor and their subcontractor's, acting together as a team. The contractor, all their subs and vendors (as required) will spend sufficient time TOGETHER at the site to ensure that all requirements are met.**
2. Equipment Start-up includes a performance verification and documentation process of ensuring that all mechanical systems are installed and are performing according to the design intent and operational needs of the project. The Start-up process encompasses a coordinated effort for system documentation, equipment startup, control system calibration, testing and balancing, and performance testing and training.
3. Equipment Start-up is separate from Commissioning. Contractor required to participate in both activities, as described in plans and specifications.
4. Equipment Start-Up not complete until ALL involved parties have completed their scopes, provided completed documentation to engineer and owner, and equipment is functioning under correct controls. If multiple visits are required to complete this task then that is what is required.
 - a. Examples of INCOMPLETE START-UP
 - 1) Test and Balance Report has deficiencies.
 - 2) Start-up forms not in possession of Engineer.
 - 3) Start-up forms missing Discharge Air temperatures.
 - 4) Units Discharge Air in cooling higher than 56 degrees.
 - 5) General Contractor wants initial cooling and Mechanical Contractor gets units running on internal controls. Mechanical must return and complete Start-Up per contract documents.
 - 6) Any units running on internal controls, in hand, or in a state of permanent override
 - b. Example of Completed Start-Up.
 - 1) Test and Balance Report has NO deficiencies.
 - 2) Start-up forms in possession of Engineer.
 - a) Mechanical and Controls
 - 3) Start-up forms have Discharge Air temperatures recorded.

- 4) All Units Discharge Air in cooling at 56 degrees or cooler.
 - a) MAU – 52 degrees or colder off coil
- 5) All units under correct controls.
5. Equipment Start-up by the contractor during the construction phase is intended to achieve the following specific objectives;
 - a. Verify that applicable equipment, controls and systems are installed according to the plans and specifications, manufacturer's recommendations and to industry accepted minimum standards.
 - b. **Verify and document proper performance of equipment and systems as a whole and as controlled by the DDC system. Verify that total integration of the mechanical and DDC systems are complete and fully operational in all modes. This requires both the mechanical contractor and the control contractor to work together at the site at the same time as required. Testing equipment operation with jumper wires or in a stand-alone mode and/or testing controls for continuity does not meet the requirements of this section.**
 - c. Verify that the Owner's operating personnel are adequately trained.
 - d. Verify balancing report is completed and outside ventilation air quantities are confirmed.
6. Controls Contractor, Mechanical Contractor and Test and Balance (T&B) Contractor must provide a signed document stating that all control integration, equipment start-up and complete test and balance (no deficiencies) has been completed prior to final mechanical inspections or initial Commissioning visit. Control integration equipment start-up and T&B reports that include outstanding deficiencies are not considered complete. All final start-up reports are to be submitted to the Owner and made available to the Engineer upon request.
7. **Schedule of Values for Equipment Start-up required on monthly Pay Application: minimum values listed below. This line item will not be approved for payment until ALL start-up forms, Contractor Readiness forms and test and balance report with no deficiencies are completed and in possession of Engineer. No partial payment will be made.**
 - a. **Mechanical Contractor - \$750/unit minimum**
 - b. **Controls Contractor - \$500/unit minimum**
 - c. **Test and Balance - \$200/ unit minimum**
8. **In addition RETAINAGE WILL NOT BE RELEASED UNTIL WORK OF THIS SECTION IS SUCCESSFULLY COMPLETED. IF THE CONTRACTOR CAN'T COMPLETE THIS WORK IN A TIMELY FASHION IT WILL BE ASSIGNED TO A THIRD PARTY FOR COMPLETION AND BILLED AGAINST THE CONTRACTORS' RETAINAGE.**
9. **Equipment Start-up forms should be 100% completed and submitted prior to calling for Final Inspections.**

- a. **Contractor Readiness forms are to be fully completed for each piece of equipment and signed off by completing technician prior to calling for final inspection.**
10. **Equipment Start-Up forms shall be treated as Contractor Readiness forms for equipment function.**
11. SPECIAL NOTE: All provisions and divisions of these specifications are a part of this section of these specifications. The Contractor shall consult these divisions and provisions in detail for instructions and include all items pertaining to this work. The Contractor shall consult all other divisions of these specifications, determine the extent of impact on the work required to complete the work required by this section of the specifications or portion thereof and related work shown on the drawings.

PART 2 - PRODUCTS

2.01 TEST EQUIPMENT

- A. All standard testing equipment required to perform startup and checkout and functional performance testing shall be provided by the contractor for the equipment being tested.
- B. Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according the Contract Documents shall be included in the base bid price to the Contractor.
- C. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.50 F and a resolution of + or - 0.10 F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals. Calibration tags shall be affixed or certificates readily available.

PART 3 - EXECUTION

3.01 MEETINGS

- A. **Pre-Start-up Meeting:** At the beginning of the project the contractor shall schedule, plan and conduct a Pre-Start-up meeting with the Owner, engineer and construction manager to discuss process and procedures to be used in Equipment Start-up process.
- B. **Miscellaneous Meetings:** Other meetings will be held throughout project at owner, engineer or contractor request during construction, to cover Equipment Start-up progress coordination, deficiencies, and other Equipment Start-up issues.

3.02 EQUIPMENT REQUIRING MANUFACTURER START-UP

- A. Standard manufacturer Start-up forms shall be submitted for review.
- B. Standard manufacturer Pre-Commissioning forms shall be submitted for review.
- C. All standard forms shall be signed and dated by technician doing Start-up and shall be included in final Equipment Start-up report.

- D. **All** Start-Up forms must include Discharge Air Temp in Cooling, High and Low speed.

3.03 TESTING CRITERIA

- A. **Systems shall be tested in all modes of operation (ie. cooling/heating, dehumidification, occupied/unoccupied modes, etc.). Systems may be started up in a stand-alone mode before control integration is complete, however all HVAC systems must be totally rechecked in all modes of operation through the manipulation of the DDC system once that part of the work is complete. Using jumper wires and testing for continuity does not meet the testing requirements.**
- B. **Tests are to be performed under conditions that simulate actual conditions where possible. Simulated test conditions are allowed in order to confirm system functions at required conditions. At completion of individual tests, all affected building equipment and setpoints shall be returned to their pre-test condition.**
- C. **Simply filling out the associated Equipment Start-up Form does not totally satisfy all requirements of this section. Perform all testing as outlined in this section. Provide signed and dated documentation of all testing. Legible field notes that are signed and dated are acceptable.**

3.04 CONTROLS

- A. A sequence shall be submitted that gives a clear concise narrative of the functional operation for each different system. This should be coordinated with control submittal.
- B. Confirm as a minimum, the following for each space sensor (temperature, humidity, CO2):
1. Verify that sensor is labeled to match associated equipment number.
 2. Verify that foam isolation pad is installed behind sensor.
 3. Verify sensor location is appropriate and not in direct airflow from adjacent grille or sunlight.
 4. Verify that sensor element is not in contact with cover, base or set point adjustment.
 5. Test sensor with separate meter adjacent to (with-in 4 inches) sensor and verify building automation system (BAS) readout is with-in tolerance. Adjust offset as required for proper calibration. Recheck sensor. Insure measuring instrument is allowed to settle out at each sensor prior to confirming reading. Temperature tolerance is +/-0 .50F, humidistat tolerance is +/- 3%.
 6. Replace any bad sensors, and document which sensor is replaced.
 7. Confirm that push button override is set for 120 minutes.
 8. Confirm that push button override is operational.
 9. Confirm that set point adjustment at thermostat is set for +/- 30F.
 10. Confirm occupied heating, cooling and RH set points.
 11. Confirm occupancy schedules. (May turn over to Owner with floor level schedule set at 7am to 4pm with no imbedded schedules at equipment level at owner's request.)

12. Confirm fan status (continuous or automatic mode).
13. Confirm that zone sensors are properly located, labeled and that they actually control the equipment that serves that zone.
14. **Physically confirm that the HVAC equipment performs all of the functions that the controls can command it to do, in all modes. Continuity check alone is NOT SUFFICIENT.**
15. **CONFIRM THAT ANY INTEGRAL UNIT MOUNTED CONTROL SETTINGS HAVE BEEN PROPERLY SET UP TO MATCH THE JOB REQUIREMENTS AND TO PROPERLY INTEGRATE WITH THE DDC SYSTEM AS INSTALLED.**

C. Document all test data for sensors, etc, on appropriate control system Equipment Start-up Forms.

3.05 ROOF TOP UNITS / SPLIT SYSTEMS/VRV/VRF/HEAT PUMPS

- A. Submit manufacturer's Start-up test report and Contractor Readiness forms.
- B. In addition to any Start-up reports perform checkout and record the following for each piece of equipment.
 1. Unit size and model number.
 2. Outside air (O/A) temperature and humidity during testing period.
 3. Verify interior of unit is clean.
 4. Insure O/A damper has been adjusted and balanced, permanently mark position of damper.
 5. Verify that fan rotation is correct.
 6. Verify that cooling coil is clean.
 7. Verify that condenser coil is clean and fins are not damaged.
 8. Verify that hail guards are installed if specified.
 9. Confirm that condensate drain and trap are installed properly and drain pan is clean.
 10. Verify that overflow switch is installed and working properly for AHU's.
 11. Verify that heating and cooling modes are functioning and record inlet and discharge air temperatures in each mode. Cooling Discharge Air should be 56 degrees or lower both high and low speed cooling.
 - a. Cooling Stage 1
 - b. Cooling Stage 2
 - c. Variable Speeds (if available on equipment)
 12. Verify that hot gas reheat is working properly in dehumidification mode. Record inlet and discharge temperature.

13. Verify that filters are clean.
 14. Confirm that belt tension and alignment has been adjusted properly.
 15. Submit documented Field Settings have been completed, per unit.
 16. VRF units REQUIRE – Factory Field Setting documentation of Actual Final setting on each unit in field. Must be documented, not just checked-off and submitted for records.
- C. Document all Equipment Start-up data on forms for Roof Top Units and on forms for Split System Units.

END OF SECTION

CONTROL SYSTEM CONTRACTOR START-UP FOR RTU'S & SPLIT SYSTEMS

FORM C1.0

Page 1 of 2

(CONTROLS CONTRACTOR)

PROJECT NAME: _____

PAGE: _____ OF _____

FULL NAME OF INDIVIDUAL PERFORMING TEST: _____

DATE: _____

#	DESCRIPTION	UNIT MARK		
1	TEMP. SENSOR LABELED			
2	HUMIDITY SENSOR LABELED			
3	CO2 SENSOR LABELED			
4	FOAM ISOLATION PAD INSTALLED BEHIND SENSOR			
5	VERIFY TEMPERATURE / HUMIDITY / CO2 SENSOR LOCATION (LIST ROOM #)			
6	LIST OFFSETS INPUT TO CALIBRATE TEMPERATURE / HUMIDITY / CO2			
7	SENSOR PUSH BUTTON OVERRIDE SET FOR 120 MINUTES & FUNCTIONAL			
8	SET POINT ADJUSTMENT AT SENSOR +/- 3 DEGREES			
9	OCCUPIED COOLING SET POINT			
10	OCCUPIED HEATING SET POINT			
11	UNOCCUPIED COOLING SET POINT			
12	UNOCCUPIED HEATING SET POINT			
13	OCCUPANCY SCHEDULE			
14	HUMIDITY SET POINT (%RH)			
15	FAN STATUS ON SS/RTU A = AUTO C = CONTINUOUS			

CONTROL SYSTEM CONTRACTOR START-UP FOR RTU'S & SPLIT SYSTEMS

FORM C1.0

Page 2 of 2

(CONTROLS CONTRACTOR)

PROJECT NAME: _____

PAGE: _____ OF _____

FULL NAME OF INDIVIDUAL PERFORMING TEST: _____

DATE: _____

#	DESCRIPTION	UNIT MARK		
16	PHYSICALLY CHECK & VERIFY THAT CONTROL SIGNAL(S) ACTUALLY INITIATES ALL MODES OF UNIT FUNCTION REQUIRED FOR THE TYPE HVAC EQUIPMENT BEING CONTROLLED.			
17	VERIFY THAT UNITS INTERNAL CONTROL SET POINTS (ECTO SETTINGS ON LENNOX RTU'S FOR EXAMPLE) HAVE BEEN SET TO MATCH THE REQUIREMENT FOR THE EXTERNAL CONTROLS ACTUALLY INSTALLED.			
18	LIST EQUIPMENT TYPE, IE, E/E SS, HP SS, GAS HEAT RTU, E.E RTU ETC...			
19A	DISCHARGE AIR TEMP COOLING LOW SPEED			
19B	DISCHARGE AIR TEMP COOLING HIGH SPEED			
20A	DISCHARGE AIR TEMP HEATING LOW SPEED			
20B	DISCHARGE AIR TEMP HEATING HIGH SPEED			
21	IF HEAT PUMP, DOES EM. HEAT COME ON DURING DEFROST CYCLE?			
22	IF HORIZONTAL SPLIT SYSTEM, IS FLOAT SWITCH WIRED INTO CONTROLS?			
23	VERIFY THAT OWNER HAS RECEIVED SPECIFIED AMOUNT OF OWNER TRAINING.			
24	VERIFY THAT SITE COMPUTER HAS BEEN INSTALLED WITH ALL REQUIRED PROGRAMMING, GRAPHICS & BACKUP CD OF SITE SPECIFIC PROGRAMMING.			

ok = ITEM VERIFIED AND ACCEPTABLE

X = ITEM NEEDS ADDITIONAL WORK AND/OR VERIFICATION

n/a = DOES NOT APPLY

REMARKS:

**POINT TO POINT CHECK OUT OF CONTROLS
DOES NOT CONSTITUTE THE FUNCTIONAL
CHECK OUT REQUIRED.**

ROOF TOP UNIT CONTRACTOR START-UP FORM C2.0

Page 1 of 1

(MECHANICAL CONTRACTOR)

PROJECT NAME: _____

PAGE: ____ OF ____

FULL NAME OF INDIVIDUAL PERFORMING TEST: _____

DATE: _____

#	DESCRIPTION	UNIT MARK		
1	UNIT SIZE / TYPE			
2	MODEL NUMBER			
3	INDOOR TEMPERATURE (AND RH IF AVAILABLE)			
4	OUTSIDE TEMPERATURE / HUMIDITY			
5	CONDITION OF UNIT INTERIOR C = CLEAN NC = NEEDS CLEANING			
6	OUTSIDE AIR DAMPER ADJUSTED AND MARKED			
7	OUTSIDE AIR HOOD INSTALLED			
8	CHECK FAN ROTATION			
9	CONDITION OF COOLING COIL C = CLEAN NC = NEEDS CLEANING			
10	CONDITION OF COND. COIL C = CLEAN NC = NEEDS CLEANING			
11	HAIL GUARD INSTALLED			
12	DRAIN PAN CLEAN			
13	CONDENSATE DRAIN AND TRAP INSTALLED PROPERLY			
14	DISCHARGE TEMPERATURE LOW SPEED			
15	DISCHARGE TEMPERATURE HIGH SPEED			
16	HEATING MODE OPERATIONAL			
17	HEATING DISCHARGE AIR TEMP.			
18	HOT GAS REHEAT DISCHARGE AIR TEMPERATURE			
19	CONDITON OF FILTERS C = CLEAN D = DIRTY			
20	BELT TENSION AND ALIGNMENT PROPERLY ADJUSTED			

ok = ITEM VERIFIED AND ACCEPTABLE

X = ITEM NEEDS ADDITIONAL WORK AND/OR VERIFICATION

n/a = DOES NOT APPLY

REMARKS:

ALL OPERATIONAL MODES ARE TO BE CHECKED BY MANIPULATING CONTROLS THAT THE OWNER WILL END UP WITH. USE OF JUMPER WIRES OR PLACING UNIT CONTROLLER IN STAND ALONE MODE IS NOT ACCEPTABLE FOR CONTRACTOR START-UP.

SPLIT SYSTEM CONTRACTOR START-UP FORM C3.0

PAGE 1 OF 2

(MECHANICAL CONTRACTOR)

PROJECT NAME: _____

PAGE: _____ OF _____

FULL NAME OF INDIVIDUAL PERFORMING TEST: _____

DATE: _____

#	DESCRIPTION	UNIT MARK		
1	UNIT SIZE / TYPE			
2	AHU MODEL NUMBER			
3	CU/HP MODEL NUMBER			
4	INDOOR TEMPERATURE (AND RH IF AVAILABLE)			
5	OUTSIDE TEMPERATURE / HUMIDITY			
6	CONDITION OF UNIT INTERIOR C = CLEAN NC = NEEDS CLEANING			
7	OUTSIDE AIR DAMPER ADJUSTED AND MARKED			
8	OUTSIDE AIR CONNECTED PER PLANS			
9	CHECK FAN ROTATION			
10	CONDITION OF INDOOR COIL C = CLEAN NC = NEEDS CLEANING			
11	CONDITION OF COND. COIL C = CLEAN NC = NEEDS CLEANING			
12	CU / HP SECURED TO ROOF SUPPORT			
13	DRAIN PAN CLEAN			

SPLIT SYSTEM CONTRACTOR START-UP

(MECHANICAL CONTRACTOR)

FORM C3.0

PAGE 2 OF 2

PROJECT NAME: _____

PAGE: _____ OF _____

INDIVIDUAL PERFORMING TEST: _____

DATE: _____

#	DESCRIPTION	UNIT MARK		
14	CONDENSATE DRAIN AND TRAP INSTALLED PROPERLY			
15	DISCHARGE AIR TEMP LOW SPEED			
16	DISCHARGE AIR TEMP HIGH SPEED			
17	HEATING MODE DISCHARGE AIR TEMPERATURE			
18	IF HP, DOES EM HEAT COME ON IN DEFROST CYCLE?			
19	HOT GAS REHEAT DISCHARGE AIR TEMPERATURE			
20	CONDITON OF FILTERS C =CLEAN D = DIRTY			
21	BELT TENSION AND ALIGNMENT PROPERLY ADJUSTED			
22	MECHANICAL CONTRACTOR: ATTACH START-UP FORM WITH REFRIGERANT PRESSURES, AMPS, ETC.			

ok = ITEM VERIFIED AND ACCEPT.

X = ITEM NEEDS ADDITIONAL WORK AND/OR VERIFICATION

n/a = DOES NOT APPLY

REMARKS:

ALL OPERATIONAL MODES ARE TO BE CHECKED BY MANIPULATING CONTROLS THAT THE OWNER WILL END UP WITH. USE OF JUMPER WIRES OR PLACING UNIT CONTROLLER IN STAND ALONE MODE IS NOT ACCEPTABLE FOR CONTRACTOR START-UP.

SECTION 23 09 00 – CONTROLS

PART 1- GENERAL

1.01 DESCRIPTION

A. Scope:

1. This section describes specific requirements, products, and methods of execution related to the system of temperature controls and instrumentation for all HVAC equipment (unless otherwise noted) on the project.
2. Provide a new DDC/BAS/EMCS control system for the entire project.
3. Provide exterior lighting control as part of Controls scope, control lighting contactors Reference Electrical Sheets.
4. Provide Power Monitoring Scope Complete in every way. Reference Electrical Sheets. Coordinate with Electrical Contractor. Must maintain 36 months of data.
5. Work to include a complete automatic temperature control including any and all control devices 120 volt and low voltage wiring (including for VRF sensors and equipment) and conduit (which is not provided by Electrical Contractor, reference Specification Sections 20 00 00 and 26 05 80) DDC controls, valves, dampers, relays and instrumentation necessary to obtain all functions and sequences hereinafter specified. Verify with Electrical Contractor on location where 120-volt power may be obtained.
6. Systems shall be Web-Based, BACNet Native/Compatible, non-Proprietary software, forward and backward compatible.
7. All Programming software tools shall be available to owner without additional purchase. Re-Programming shall not require additional hardware.
8. OWNER'S INSTRUCTIONS:
 - a. Provide an instruction period lasting no less than 20 hours to completely familiarize operating personnel with the control systems on the project. Schedule times with Owner. Assume blocks of 4hour training.
 - b. Session shall be job specific/hands-on training. Obtain written certification that this instruction period has taken place. Instruction session should only occur after all as-built drawings have been completed and all documentation concerning control programs, control point indications and other pertinent data necessary for the project are completed.
 - c. **Control training sessions to be videotaped in non-pixelated video in Windows file format or other format requested by Owner.**
9. Control System must be Native BacNet over IP (BacNet is only used as described in specification. All other instances contractor provide controllers and sensors.)
10. Provide a Unit Controller for **ALL** units on job unless specifically noted, no controller required.

11. MDF/IDF/Electric Rooms: (no Controller required) BAS to provide sensor to monitor room temperature in new MDF/IDF/Electric rooms and provide alarm when out of range. Do not tie into unit controls.
12. MAU Units (DX) – provide unit controller for control of unit, BacNet interface allowed for receiving information from unit, accommodate any BacNet language provided. Coordinate exact control and interface strategy with manufacture.
13. RTU-VAV Units (DX) (no Controller required) – provide complete BacNet interface of Any BacNet language provided.
14. HETD/Multizone Units (DX) (no Controller required) – provide complete BacNet interface of Any BacNet language provided.
15. **VRF – VRV when master VRF controller present. (hybrid Bacnet and DDC controller and Sensors) Provide complete BacNet interface of any BacNet language provided. Reference VRF Controls Specification For additional requirements (when installed on project).**
16. **VRF/VRV/Inverter Compressor Heat Pumps (Stand Alone Option) – provide controller for each unit, like ALL other units.**
17. **For units that have BacNet interface, when points are specified that cannot be acquired through BacNet, or require sensor by Controls Contractor, Controls contractor to provide controllers and sensors required to acquire ALL points listed; in addition to BacNet interface (ie discharge air sensor).**
18. If there is a question about an overlap of 3rd party controller for a unit with a unit mounted controller, controls contractor to assume to provide a controller, compile a detailed list of units in question with bid and provide a deductive unit price to delete controllers from individual units. This will be reviewed by Engineer and direction given.
19. Coordinate shut down requirement of unit with Fire Alarm Contractor. Mechanical Contractor to make required connection inside HVAC units as required. Reference Sequence of Operation.
20. Provide Internet access (Cellular HOT SPOT) for BMS system to have remote programming available so that all programming can begin prior to permanent Internet access being available. All Graphics and Controls systems should be operational minimum **3 months** prior to substantial completion.
21. Must meet ALL Owner standards.
22. Commissioning Requirements: (reference Commissioning Specifications)
 - a. Contractor required to show compliance with code required and Owner required commissioning scope.
 - b. Contractor to obtain a Fieldwire Pro software license or other software license required by Commissioning Agent for the duration of the project commissioning.

- c. **Provide all information and participate in all meetings required by Equipment Start-Up, Test and Balance, Controls Integration with others, and Commissioning Specification to ensure HVAC system is function properly, and passes Functional Testing during Commissioning of HVAC System.**
 - d. **Money will be held until ALL CX activities are addressed and completed.**
 - 23. Contractor to set data logging on **ALL** points shown on graphics, to data log once per 30 seconds for 90 days history minimum, until commissioning is complete, then can be adjusted to final owner requirements.
- B. Contractor Qualification Requirements:
 - 1. Furnish the services of a qualified and approved temperature control subcontractor to provide the work of this specifications section. Unless otherwise noted, this is substantially a "performance" specification.
 - a. Maintain a complete engineering, sales, installation, and service organization that has operated within the 30 Miles of Project / Austin area for at least three years prior to bid date of this project.
 - b. Maintain a full-time service office providing complete service capability during the warranty period.
 - c. Demonstrate the capability to provide service after the warranty period, within 24 hours of notice.
 - d. Maintain a complete stock of replacement parts.
 - e. Remain on 24-hour call for emergency service.
 - f. Demonstrate satisfactory completion of five projects of similar size and scope. Provide references if requested.
 - g. All application design of the DDC control system shall be performed in the office of the control system manufacturer by system analysts skilled and experienced in control design of HVAC system similar to those specified herein. In addition to the language manuals, flow charts, listing, and other documentation specified, the manufacturer shall maintain a software test, debug, and development facility in their office to support software additions and modifications in an off-line environment to minimize on-site disruptions during major changes. At the end of the warranty period, the Contractor shall prepare two duplicate copies of all control software on non-volatile magnetic media.
 - h. The entire system provided by the Contractor and installed by mechanics regularly employed by the manufacturer of temperature control equipment. Bids by wholesalers, Contractors or any firm whose established business is not that of installing automatic temperature control systems are not acceptable.
- C. Acceptable Control Systems: (**Base Bid must include Base Bid Controls**)
 - 1. Base Bid: Reliable Controls: ESC Brennan Mittal (210)902-9828.
 - 2. Alternate 2: Automated Logic (ALC): Jennifer Peterson (512)809-2685 or Jose Vazquez (210)419-7408

3. Alternate 1: Alerton: Climatec, (512)358-0703
4. Tempset Controls: Ken Smith (512)595-4067
5. Trane Trace Controls: Trane(G) (512)213-8575
6. Owner may invite the Controls Contractor to do a presentation to demonstrate features, benefits and service prior to award of contract.

1.02 SUBMITTALS

- A. Data Sheets for all control systems and components.
- B. Submit Sample Graphics for: Overall Site, Floor Plan Overall, Floor Plan Area, All unit Types, Power Monitoring etc. Include all information to be displayed. (see attached for reference) This is part of Initial Control Submittal, not at end of project. Submittal will be rejected if these are not included.
- C. Submit detailed sequence of operation, including set points.
- D. Submit damper schedule showing size, configuration, capacity, and location of each.
- E. Submit control system drawings containing pertinent data to provide a functional operating system, including a written sequence of operation easily recognized as that specified. Submit detailed shop drawings in as-built form upon project completion. Show each system complete on one drawing.
- F. Provide Point to Point diagram for all points.
- G. An operator's manual which will include detailed instructions for all operations.
- H. An operator's reference table listing the addresses of all connected input points, output points and unguarded software parameters. Settings shall be shown where applicable.
- I. Provide sample of room sensor for Owner approval. (No display with override button and room temperature adjust)
- J. Prior to occupancy by user, provide control diagrams for all systems approximately 12" X 18" in size, reduced from the as-built control drawings and laminated in heavy clear plastic, two copies of each, with one copy in a ring binder and the other copy located inside its applicable control panel door.

1.03 ADJUSTMENT/CALIBRATION

- A. **Provide ALL Commissioning Forms completed showing all sensors, controllers etc.. are calibrated. Upon completion of the project, adjust and validate all sensors, controllers, damper operators, relays, etc., provided under this section. Place controls in proper operating order while working in close coordination with the Mechanical Contractor, Testing & Balancing Agency and then demonstrate to the satisfaction of the Mechanical Contractor, Engineer, Commissioning Agent and Owner that the control system actually makes the controlled equipment perform the sequences specified and are functioning in perfect operating order. Point to point checkout of the controls do not satisfy this requirement.**

1.04 INSTRUCTION

- A. Provide operation and maintenance manuals per Section 20 00 00 covering the function and operation of the control systems on the project. Obtain written certification that this instruction period has taken place. Instruction session should only occur after all as-built drawings have been completed and all documentation concerning control programs, control point indications and other pertinent data necessary for the operation of the control system has been organized in a manual for the Owner.

1.05 GUARANTEE

- A. Parts Warranty : 5 years (all Functional Devices including controllers, panels, sensors)
- B. Labor Warranty : Base Bid: 1 year. Provide Add Alternate for additional 1 year of labor warranty.
- C. **Upon acceptance of the building by the Owner or use of the equipment by the Owner for its intended purpose, whichever occurs first, a warranty period of TWO years commences. The warranty consists of providing, at no additional cost to the Owner, parts and labor as required to repair or replace such parts of the temperature control system that prove inoperative or faulty due to defective materials, control system design, or installation practices including any service calls required for proper operation and performance of the control system. This warranty excludes routine service.**
- D. Upon completion of the installation the Contractor shall inspect, check, regulate, and adjust the control system and certify that they are installed in accordance with “record drawings.” **PROVIDE CHECKOUT DOCUMENTATION WHEN COMPLETE.**
- E. Factory trained employees of the manufacturer’s office shall perform all maintenance and guarantee work and shall respond within four hours of notification during normal working hours.

PART 2 - PRODUCTS

2.01 GENERAL

- A. General: BacNet over MSTP/IP. Control system to have ALL IP based controllers. The system shall be an enterprise-level multiple building control system as indicated on the drawings and described in the specifications. Control functions within a building site shall be performed by localized direct digital controls linked through a peer-to-peer network of building controllers. The system shall provide a web-based user interface and be designed to integrate multiple BACnet-based systems together, collect, store and display historical data and provide enterprise-wide or multiple building facilities management capabilities from a central storage and operational location.
- B. An operator shall be able to logon to the system using a standard web browser, and without requiring system vendor-proprietary software installed on the user’s PC to allow access to all appropriate data and control functions.
 - 1. Direct Digital Control (DDC) technology shall be used to provide the functions necessary for control of systems defined for control on this project.
 - 2. All controllers shall be freely programmable. The use of application specific controllers will not be accepted (unless OEM specified equipment).
 - 3. Controllers provided should have enough points for equipment to be 2 speed heating and 2 speed cooling for every equipment type, even if existing equipment is single speed.

Future equipment will be multi-speed and require these points.

4. The control system shall accommodate simultaneous multiple user operation. Access to the control system data should be limited by operator password. An operator shall be able to log onto any workstation of the control system and have access to all designated data.
 5. The control system shall be designed such that each mechanical system will operate under stand-alone control. As such, in the event of a network communication failure, or the loss of other controllers, the control system shall continue to independently operate the unaffected equipment.
 6. Communication between the control panels and all workstations shall be over a high-speed network. All nodes on this network shall be peers. A network communications card shall be provided for each building control panel provided as part of the system installation.
- C. All temperature control devices shall be standard catalog products and shall essentially duplicate equipment which has been in satisfactory service for at least 1 year. A minimum of 90% of the control equipment shall be manufactured by the installing manufacturer. The equipment guarantee on all equipment shall be by the installing manufacturer.
- D. OPEN INTEROPERABLE, INTEGRATED ARCHITECTURES
1. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate both the ANSI/ASHRAE Standard 135-2020 BACnet.
 2. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data will not be acceptable.

2.02 BACnet COMPATIBILITY

- A. The system must be fully BACnet compatible at the time of installation. This means that the system must **use BACnet as the native communication protocol in accordance with ASHRAE standards**, between distributed controllers communicating on the controller network (i.e. Field Bus) and must, as a minimum, support the following Objects and Application Services (Conformance Class 3):
1. Objects > Binary Input
 2. Services> Readproperty
 3. Binary Output Writeproperty
 4. Binary Value I-Am
 5. Analog Input I-Have
 6. Analog Output ReadMutipleProperty
 7. Analog Value WriteMultipleProperty
 8. Calendar Who-Has
 9. Schedules Who-Is

- B. The communication network between controllers must be EIA-485, using MS/TP. Control system to have ALL IP based controllers communication. MSTP backup only. Systems that use proprietary protocol for the main controller field bus are not acceptable.

2.03 ELECTRICAL WORK

- A. All electrical installation work related to the temperature control system, including the electrical interlocks required to provide the control sequences specified herein and not specifically specified in Division 26-28 or shown on the electrical drawings shall be the responsibility of the Controls Contractor. Electrical work performed under this section shall conform with all requirements of Section 16 of these specifications with the following exceptions as to wire type and minimum size:
1. Interlock/Monitoring: #16 Ga, 600 volt THHN insulation. (For IP based systems use CAT5E or CAT6(ask owner preference, cost) wire, coordinate color code with Owner Standards.)
 2. "DDC" Communication Bus: As recommended by the control manufacturer.
 3. "DDC" Digital Sensors: As recommended by the control manufacturer.
 4. "DDC" Analog Sensors: As recommended by the control manufacturer.
- B. **All required monitoring, control wiring, exposed conduit to control cabinets and DDC equipment, operators, etc. shall be provided under this Division of the specifications.**
- C. CONTROLS CONTRACTOR SHALL PROVIDE: ALL CONTROL WIRING. ON IP BASED SYSTEMS USING CAT5E, COORDINATE COLOR CODE WITH OWNER STANDARDS. ALL CONTROL WIRING TO BE PLENUM RATED TYPE. CONDUIT FROM JUNCTION BOX IN WALL FOR SENSORS TO ABOVE ACCESSIBLE CEILING LINE AND EXTERIOR CONTROL CONDUIT IS PROVIDED AND INSTALLED BY ELECTRICAL CONTRACTOR. CONTROLS CONTRACTOR TO PROVIDE AND INSTALL ALL EXPOSED CONDUIT WITHIN BUILDING AS REQUIRED. CONTROL WIRING CAN BE NEATLY RUN WITHOUT CONDUIT IN ACCESSIBLE CEILING CAVITIES.
- D. Electrical Contractor to provide 120V, 20 Amp dedicated circuit to main building control module on site and install data line next to receptacle. Coordinate final location of power and data connection with Electrical Contractor.
1. General Contractor: Provide 20amp/1pole breaker, dedicated circuit, ½" conduit, 3#12 wire, estimate 200 ft. MC cable acceptable.
 2. DDC Panel Location and Power: BAS Contractor to use existing 120v panel locations first, then coordinate any additional locations with GC, EC.

2.04 MOTORIZED CONTROL DAMPERS

- A. All control dampers, except smoke and fire/smoke dampers shall be furnished by the temperature control manufacturer, except those specified to be furnished with an air handling unit, exhaust fan or other equipment. Smoke dampers and combination fire/smoke dampers with electric actuators shall be furnished and installed by the Sheetmetal Contractor. The Electrical Contractor shall furnish and install all interlock equipment to interlock the smoke and fire/smoke dampers with fire alarm system as hereinafter specified.
- B. Damper frames minimum 13-gauge sheet metal or steel channel suitable for application (with flanges for duct mounting as required).

- C. Damper blades minimum 16-gauge and shall not exceed eight inches (8") in width and shall be suitable for high velocity performance.
- D. All damper bearings are to be made of nylon. Bushings that turn in the bearings are to be oil impregnated sintered metal. Replaceable butyl rubber seals are to be provided with the damper. Seals are to be installed along the top, bottom, and sides of the frame and along each blade edge. Seals shall provide a tight closing, low leakage damper.
- E. Linkage, which shall provide a linear flow characteristic, shall be provided with the damper operator for all applications (constant pressure drop).
- F. Leakage shall meet Class 3 requirements for low pressure ductwork.
- G. Leakage and flow characteristic charts must be submitted to the Engineer.

2.05 DAMPER OPERATORS

- A. Damper operators shall be modulating electronic type with bracket arrangements for location outside the air stream wherever possible. All dampers of sufficient size to operate their respective dampers or group of dampers.
- B. Mount operator outside the air stream wherever possible.
- C. Provide external adjustable stops to limit stroke.

2.06 ACTUATORS

- A. All actuators shall be provided from the same manufacturer as of the BAS and shall bear the name of the BAS manufacturer.
- B. Actuators shall be provided from a manufacturer registered under ISO9001:2000.
- C. Electronic Damper Actuators shall have the following characteristics:
 - 1. Size for torque required for damper seal at load conditions.
 - 2. Coupling: V-bolt dual nut clamp with a V-shaped, toothed cradle.
 - 3. Mounting: Actuators shall be capable of being mechanically and electrically paralleled to increase torque if required.
 - 4. Overload Protection: Electronic overload or digital rotation-sensing circuitry without the use of end switches to prevent any damage to the actuator during a stall condition.
 - 5. Fail-Safe Operation: Mechanical, spring-return mechanism. Internal chemical storage systems, capacitors, or other internal non-mechanical forms of fail-safe operation are not acceptable.
 - 6. Power Requirements (Two-Position Spring Return): 24 or 120 VAC as required.
 - 7. Power Requirements (Proportional): Maximum 10 VA at 24 VAC or 8 W at 24 VDC.
 - 8. Temperature Rating: -22 to +122°F (-30 to +50°C)
 - 9. Housing: Minimum requirement NEMA type 2 / IP54 mounted in any orientation.

10. Agency Listing: ISO 9001, UL, UL(C) and CSA C22.2 No. 24-93.

D. Terminal unit Actuators shall have the following characteristics:

1. Close-off (Differential) Pressure Rating: 200 psi.
2. Coupling: V-bolt dual nut clamp with a V-shaped, toothed cradle or an ISO-style direct-coupled mounting pad.
3. Power Requirements: Maximum 1 VA at 24 VAC or 1 W at 24 VDC.
4. Temperature Rating: -22 to +122°F (-30 to +50°C). Housing Rating: Minimum UL94-5V(B) flammability.
5. Agency Listing: CE, UL 60730-1A/-2-14, CAN/CSA E60730-1, CSA C22.2 No. 24-93, CE according to 89/336/EEC.

2.07 CORROSION RESISTANT FINISH

A. Provide a special factory applied corrosion resistant finish all dampers, damper actuators, system mounted controls, valves, room instruments, transmitters, etc., with exposed surfaces subject to corrosion.

2.08 SYSTEM PERFORMANCE

- A. Data values displayed on web pages (that represent live data) shall automatically refresh at a minimum rate of every 10 seconds in the browser without refreshing the entire page.
- B. Data on web pages must be returned and updated on a given web page within 5 seconds on average after the web page is initially delivered, subject to network loading.
- C. Graphic Display. The system shall display a graphic with a minimum of 20 dynamic points with current data displayed within 20 seconds of the request.
- D. Graphic Refresh. The system shall update all dynamic points with current data within 30 seconds.
- E. Object Command. The maximum time between the command of a binary object by the operator and the reaction by the device shall be 10 seconds. Analog objects shall start to adjust within 10 seconds.
- F. Object Scan. All changes of state and change of analog values shall be transmitted over the high-speed network such that any data used or displayed at a controller or workstation will be current, within the prior 60 seconds.
- G. Alarm Response Time. The maximum time from when an object goes into alarm to when it is viewable on an operator workstation web page shall not exceed 45 seconds.
- H. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 seconds. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.
- I. Performance. Programmable Controllers shall be able to execute DDC PID control loops at a selectable frequency from at least once every 5 seconds. The controller shall scan and update the process value and output generated by this calculation at this same frequency.

- J. Multiple Alarm Annunciation. Any authorized operator shall be able to view alarms through a web page interface, with up to 40 concurrent users accessing the system alarm data.
- K. Reporting Accuracy. Table 1 lists minimum acceptable reporting accuracies for all values reported by the specified system.

**Table 1
Reporting Accuracy**

Measured Variable	Reported Accuracy
Space Temperature	±0.5°C [±1°F]
Ducted Air	±1.0°C [±2°F]
Outside Air	±1.0°C [±2°F]
Delta-T	±0.15°C[±0.25°F]
Relative Humidity	±5% RH
Air Flow (measuring stations)	±5% of reading
Electrical Power	± 5% of reading *Note 3
Carbon Dioxide (CO2)	± 50 PPM

Note 1: (10%-100% of scale) (cannot read accurately below 10%)

Note 2: for both absolute and differential pressure

Note 3: * not including utility supplied meters

2.09 COMMUNICATION

- A. This project shall comprise of a network utilizing high-speed BACnet over IP communications between the Central Server, Building Controllers, and the Operator PC Workstations
- B. This Contractor shall provide all communication media, connectors, repeaters, hubs, and routers necessary for the DDC system internetwork within buildings designated and arrange for an interface point to the customer's WAN for inter-building communications.

2.10 OPERATOR INTERFACE

- A. **Provide a web browser user interface with unlimited users.** There shall be no vendor-proprietary software required to be installed on user PCs.
 1. The system shall provide summary tables by equipment type per site. Room or space summary tables shall provide names, space temperatures, setpoints, and variance from setpoint. Provide a means to sort columns of data viewed by ascending or descending value for any chosen data type.
 2. The system shall provide a user option to reformat summary tables and information for printing.
 3. The central server shall be capable of presenting selected data parameters such that they may be viewed and changed by the user. For example, adjustable data parameters may include space temperature setpoints, relative humidity setpoints, discharge air setpoints, static pressure setpoints,
 4. Provide the ability to reset diagnostic messages and perform control overrides.

2.11 SYSTEM SOFTWARE

- A. System Graphics. The operator interface shall provide graphically-oriented web pages as designated.
 - 1. Provide a method for the operator to easily move between graphic displays on the screen.
 - 2. The system must dynamically generate and serve web pages based on standard or custom web page templates in combination with content derived from the database in any building control panel.
 - 3. Dynamic points shall include analog and binary values, dynamic text, static text, and animation files. Graphics shall have the ability to show animation of equipment.
- B. Engineering Units. Allow for selection of the desired engineering units (i.e. Inch pound or SI) in the system. Unit selection shall be able to be customized by user to select the desired units for each measurement.
- C. Site Management
 - 1. The system must allow for grouping of the many sites in an enterprise in a logical manner.
 - 2. The system shall provide a search function to allow users to search for sites or groups of sites by name or partial names.
 - 3. The system must provide the necessary means to add, remove, and manage sites.

2.12 SYSTEM APPLICATIONS

- A. The central server shall serve operator interface web pages and provide off-line storage of system information. Provide application to match existing system.

2.13 BUILDING CONTROLLERS

- A. General. Provide Building Controllers to meet the following requirements.
 - 1. The Building Automation System shall be composed of one or more independent, standalone, microprocessor-based Building Controllers to manage the global strategies described in System software section.
 - 2. The Building Controller shall have sufficient memory to support its operating system, database, and programming requirements.
 - 3. The controller shall provide a communications port for connection of the Portable Operators Terminal.
 - 4. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
 - 5. Controllers that perform scheduling shall have a real time clock.
 - 6. Data shall be shared between networked Building Controllers.

7. The Building Controller shall utilize industry recognized open standard protocols for communication to unit controllers.
8. The Building Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:
 - a. Assume a predetermined failure mode.
 - b. Generate an alarm notification.
 - c. Create a retrievable file of the state of all applicable memory locations at the time of the failure.
 - d. Automatically reset the Building Controller to return to a normal operating mode.

2.14 AUXILIARY CONTROL DEVICES

- A. Motorized dampers, unless otherwise specified elsewhere, shall be as follows:
 1. Damper frames shall be 16-gauge galvanized sheet metal or 1/8" extruded aluminum with reinforced corner bracing.
 2. Damper blades shall not exceed 8" in width or 48" in length. Blades are to be suitable for medium velocity performance (2,000 fpm). Blades shall be not less than 16 gauge.
 3. Damper shaft bearings shall be as recommended by manufacturer for application.
 4. All blade edges and top and bottom of the frame shall be provided with compressible seals. Side seals shall be compressible stainless steel. The blade seals shall provide for a maximum leakage rate of 10 CFM per square foot at 2.5" w.c. differential pressure.
 5. All leakage testing and pressure ratings will be based on AMCA Publication 500.
 6. Individual damper sections shall not be larger than 48" x 60". Provide a minimum of one damper actuator per section.
- B. Control dampers shall be parallel or opposed blade types as scheduled on drawings.
- C. Electric damper/valve actuators.
 1. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.
 2. Where shown, for power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing.
 3. All rotary spring return actuators shall be capable with both clockwise or counter-clockwise spring return operation. Linear actuators shall spring return to the retracted position.
 4. Proportional actuators shall accept a 0-10 VDC or 0-20 mA control signal and provide a 2-10 VDC or 4-20 mA operating range.
 5. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb. torque capacity shall have a manual crank for this purpose.

6. Actuators shall be provided with a conduit fitting and a minimum 1m electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
7. Actuators shall be Underwriters Laboratories Standard 873 listed.
8. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque.

D. Binary Temperature Devices

1. Low-Voltage Space Thermostats shall be 24 V, bimetal-operated, mercury-switch type, with either adjustable or fixed anticipation heater, concealed setpoint adjustment, 13°C-30°C (55°F-85°F) setpoint range, 1°C (2°F) maximum differential, and vented cover.
2. Line-Voltage Space Thermostats shall be bimetal-actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed setpoint adjustment, 13°C-30°C (55°F-85°F) setpoint range, 1°C (2°F) maximum differential, and vented cover.
3. Low-Limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least 6 m (20 ft) long. Element shall sense temperature in each 30 cm (1 ft) section and shall respond to lowest sensed temperature. Low-limit thermostat shall be manual reset only.

E. Temperature Sensors

1. Temperature sensors shall be Thermistor.
2. Duct sensors shall be rigid or averaging as shown. Averaging sensors shall be a minimum of 1.5m [5 feet] in length.
3. Immersion sensors shall be provided with a separable stainless steel well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed.
4. Space sensors shall be equipped with set-point adjustment, override switch and/or communication port. **Provide sensor for each unit.** Provide sample for owner approval.
5. Provide matched temperature sensors for differential temperature measurement. Differential accuracy shall be within 0.1 C [0.2 F].
6. Discharge Supply Air Temperature Sensors: Sensing element securely mounted in element holder and placed in optimum position in supply duct.
 - a. **BAS Contractor to supply duct temperature sensors and controllers for HETD's, CWRTU, AHU's, RTU's and MAU's, etc. (ALL SPECIFIED UNITS THAT SUPPLY HEATED OR COOLED AIR.)**

F. Humidity Sensors

1. Duct and room sensors shall have a sensing range of 20% to 80% with accuracy of ±5% R.H.
2. Duct sensors shall be provided with a sampling chamber.

3. Outdoor air humidity sensors shall have a sensing range of 20% to 95% R.H. It shall be suitable for ambient conditions of -40° C to 75° C [-40° F to 170° F].
4. Humidity sensor's drift shall not exceed 1% of full scale per year.

G. Carbon Dioxide (CO₂) Sensors

1. Carbon Dioxide sensors shall measure CO₂ in PPM in a range of 0-2000 ppm. Accuracy shall be +/- 3% of reading with stability within 5% over 5 years. Sensors shall be duct or space mounted as indicated in the sequence of operation.

H. Relays

1. Control relays shall be UL listed plug-in type with dust cover. Contact rating, configuration, and coil voltage suitable for application.
2. Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable plus or minus 200% (minimum) from set-point shown on plans. Contact rating, configuration, and coil voltage suitable for application. Provide NEMA 1 Type enclosure when not installed in local control panel.

I. Transformers and Power Supplies

1. Control transformers shall be UL listed, Class 2 current-limiting type, or shall be furnished with over-current protection in both primary and secondary circuits for Class 2 service.
2. Unit output shall match the required output current and voltage requirements. Current output shall allow for a 50% safety factor. Output ripple shall be 3.0 mV maximum Peak-to-Peak. Regulation shall be 0.10% line and load combined, with 50 microsecond response time for 50% load changes. Unit shall have built-in over-voltage protection.
3. Unit shall operate between 0° C and 50° C.
4. Unit shall be UL recognized.
5. Controls Contractor is responsible for sizing of control transformer for load encountered.
6. Control Contractor is responsible for correctly phasing control transformer when required.

J. Current Switches

1. Current-operated switches shall be self-powered, solid state with adjustable trip current. The switches shall be selected to match the current of the application and output requirements of the DDC system.

K. Local Control Panels

1. All indoor control cabinets shall be fully enclosed NEMA 1 Type construction with hinged door, and removable sub-panels or electrical sub-assemblies.
2. Interconnections between internal and face-mounted devices shall be pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL listed for 600-volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.

3. Provide on/off power switch with over-current protection for control power sources to each local panel.

L. **Points:**

1. **Provide all points as required by sequence of operation (unless OEM provide controls with BACnet interface) for the actual equipment being controlled. For all equipment controlled by BAS System, provide individual points for occupied/unoccupied, start/stop, status, space temperature, supply air temperature, compressor command status, run status, heat command status, override, and control valve status. Also provide space humidity and CO2 points as required. All to be adjustable from unitary controller terminal via laptop computer or main computer at the school Owner's main office as well as from web.**
2. **Provide any additional point required by owner, from owner points list standard.**

M. Schedules:

1. System shall provide for easily programmable standard scheduler and holiday scheduler. Controls contractor to program in full calendar year.
2. **Provide advanced scheduling tool that will allow the operator to apply one time, unique events, schedule to single or multiple units regardless of their standard schedules. After special event time schedule has elapsed, schedule automatically reverts back to standard schedules. Confirm special events with Owner.**

2.15 GRAPHICS

A. The Graphics shall make extensive use of color to communicate information related to set-points and comfort, and shall comply with the following: (reference sample graphics attached for minimum display requirements)

1. Dynamic Color Graphic Displays
 - a. Create Site Layout Color graphic including building penetration Icons, building floor plan displays with room temperatures and other building sensors values dynamically displayed. Icon links on the floor plans will allow penetration to the building Mechanical equipment. Provide System graphics for each piece of mechanical equipment, as applicable, with dispersed dynamic data as indicated in the system point I/O summary of this specification. Points required by the sequence of operations shall also be displayed even if they are not defined by the I/O schedule to optimize system performance analysis and speed alarm recognition. Provide as a minimum the following graphics.
 - 1) Site layout
 - 2) Overall Building Floor plan/Area floor plans showing room sensor location, room temperature and actual room numbers. Get actual room numbers prior to programming.
 - 3) **Individual unit graphics.** Provide a unit graphic for each piece of equipment. On individual graphic provide link to written control sequence and wiring for specific piece of equipment.

- a) See Attached Sample. At minimum provide on graphic ALL information shown on sample as well as addition information required for additional options a piece of equipment may have.
- 4) Equipment shall be shown on the floor plans, clicking on the device will display all data associated with the device. Freezer/Cooler sensor to appear on main floor plan graphic.
- 5) All graphics will provide in addition to the system points the following. They are:
 - a) Graphic Orientation:
 - Unit Label: Prominent at top of graphic. Unit Label shall be label from plans first followed by room description (coordinate final description with owner, typical room description is final room numbers decided later in project) EX. RTU – 1B (Room B111) , EX. RTU - 1E (Cafeteria)
 - Air Flow should orient from Left to Right. Supply on Right.
 - Return Air enter unit from bottom
 - Outside Air enter unit from Left.
 - Data displayed near component represented. Additional data can be organized in chart below.
 - b) Outside air temperatures (global) top left
 - c) Outside air humidity (global) top left
 - d) Outside air CO2 level (global) top left
 - e) Current date and time (on every graphic). (top left).
 - f) Provide “previous” button on all system graphics and in all pages (top left)
 - g) Provide button link to schedules.
 - h) Link to pdf of construction documents, equipment submittal, control submittal, mechanical shop drawings, final test and balance report.
- 6) Equipment Matrix: Create equipment specific matrix from BACnet points indicated on specific unit Point Chart at end of this section with link from specific equipment graphic.
- 7) Provide matrix of all equipment to indicate sensor setpoint, actual space temperature and duct discharge supply air sensor common to equipment graphics and general alarm point. This matrix to indicate equipment number or sensor number from mechanical plans, plan room number and actual room number. Include button link back to equipment graphic for each unit.

- 8) Make-up-Air/Outside Air (MAU/OA) Unit: On graphic for makeup air units. See sample graphic. At minimum provide on graphic ALL information shown on sample as well as additional information required for additional options a piece of equipment may have and include scheduled cfm next to actual cfm for reference.
- 9) AHU/RTU-VAV Unit: In addition to points listed above. Provide summary of chart of FP/VAV's served on unit graphic. At minimum include FP/VAV: Unit Label, Space Temp, Setpoint, Discharge Air Temp, Heater %, Damper Position, Actual CFM, Box Max CFM, Fan Status(FP only). Chart to be clickable to link to VAV/FP unit.
- 10) Graphic to indicate area (zone) being served by unit.
- 11) Extra Graphic Items: Do NOT put extra graphical items on unit graphics, when the option or accessory is not part of unit. IE: On a RTU graphic, if the unit does not have an outside air damper, do not put a damper on that unit graphic. Only put Outside Air dampers on graphics of units that have that specific accessory.
- 12) Dampers: Damper information to include: command and status, when variable position is available show (percent) % open.
- 13) Air Flow Monitoring (AFM): when airflow monitoring stations are specified for fan cfm. Locate CFM text next to fan, show scheduled fan cfm and show actual reading from AFM.
- 14) Fans: list command status, actual status, vfd speed (when vfd present)
- 15) Provide equipment summary matrix page for all individual groups of equipment.

Submit graphics for approval from Owner and Engineer prior to system setup and checkout.

- a. The operator interface shall allow users to access the various system schematics and floor plans via a graphical penetration scheme, menu selection or text-based commands. Graphics software shall permit the importing of Auto-Cad or Bitmap drawings for use in the system.
- b. Temperature values, humidity values, flow values and status indication shall be shown in their actual respective locations and shall automatically update to represent current conditions without operator intervention and without pre- defined screen refresh rates.
 - 1) Analog sliders or rotating knobs shall be available for monitor and control of analog values; high and low alarm limit settings shall be available and displayed separately. The user shall be able to "click and drag" the pointer to change the set point.
 - 2) Provide the user the ability to display blocks of point data by defined point groups; alarm conditions shall be displayed by flashing point blocks.
 - 3) Equipment state can be changed by clicking on the graphic symbol and selecting the new state (on /off) or set point.

- 4) Colors shall be used to indicate status and change as the status of the equipment changes. The state colors shall be user definable. Verify with Owner on final color. Colors to indicate satisfied, hot or cold only.
 - 5) The windowing environment of the PC operator workstation shall allow the users to simultaneously view several applications at a time to analyze total building operation or to allow the display of a graphic associated with an alarm to be viewed without interrupting work in progress.
 - 6) Off the shelf graphic/photo bitmap editing software, shall be provided to allow the user to add, modify or delete system graphic displays.
 - 7) A library of static and animated HVAC and automation symbols shall be provided including fans, valves, motors, Chillers, AHU systems, standard ductwork diagrams and laboratory symbols that pertain to each project specific. The user shall have the ability to add custom symbols to the library.
2. Equipment operation schedules shall be definable for the entire system, area or individual equipment. For example, a user shall have the ability to define a single common occupancy schedule for every piece of equipment within a system or an area. Users with access to multiple systems shall have the ability to define a single common schedule, which affects multiple systems. Changes to the single schedule shall be made at this single point and shall automatically be passed to all equipment and individual controllers within the system without further user intervention. Exceptions to this single common schedule or additional occupancies shall be made at any area or equipment level. The schedule display for any piece of equipment shall clearly indicate associated schedules.

PART 3 - EXECUTION

3.01 COORDINATION

- A. Coordinate this work with the work of other trades and make arrangements for the complete and proper accomplishment of all related work. The following division of responsibility is suggested:
1. The Mechanical Contractor:
 - a. Installs smoke duct detector in ductwork. Provided by the Fire Alarm Contractor. Final connection by the Fire Alarm Contractor. Install smoke detectors in R/A ahead of any fresh air inlet and in supply air discharge or as required by code.
 - b. Installs all automatic dampers and provides blank-off plates or transitions required to install dampers that are smaller than duct size.
 - c. Assemble multiple sectioned dampers with required interconnecting linkages and extend required number of shafts through duct for external mounting of damper motors.
 - d. Provide sheet-metal baffle plates to eliminate stratification and provide air volumes specified. Locates baffles by experimentation and fix and seal permanently in place only after stratification problems have been eliminated.
 - e. Provide access doors or other approved means of access through ducts for service to control equipment.

- f. **PROVIDE FACTORY START-UP BY FACTORY AUTHORIZED TECHNICIAN PRIOR TO INTERFACE WITH BUILDING AUTOMATION SYSTEM.(THIS CANNOT BE DELETED OR EXCLUDED). THESE REPORTS MUST BE SUBMITTED TO THE OWNER AND BE MADE AVAILABLE TO THE ENGINEER UPON REQUEST.**
 - g. Provide Controls Contractor with points list (PICS: BACnet Protocol Implementation Conformance Statement) for all equipment for proper coordination.
 - h. **Contractor shall complete ALL Start-up, Contractor Readiness forms and Commissioning Forms.**
 - i. **Contractor to complete all items identified in the Commissioning Report.**
2. The Controls Contractor:
- a. Furnish all control products to accomplish the specified sequences of operation, except those products specifically furnished under other sections.
 - b. Install all control products and connections, except where other arrangements have been made, as above.
 - c. Provide and install control step down transformers and wiring at all equipment required for system control operation. Correctly phase transformers when used.
 - d. Control Contractor to supply and connect all controllers, sensors, devices and modular controller for a complete and operational system.
 - e. Controls Contractor to perform a verification, point-by-point, test of the controls system to insure all sequences are working properly in all modes.
 - f. **CONTROL CONTRACTOR IS REQUIRED TO DO A COMPLETE OPERATIONAL CHECKOUT OF HVAC EQUIPMENT BY MANIPULATING THE CONTROL SYSTEM TO MAKE SURE THE SYSTEM IS PROPERLY INTEGRATED AND THAT THE EQUIPMENT ACTUALLY DOES WHAT THE CONTROLS COMMAND IT TO DO, IN ALL MODES OF OPERATION. CONTROLS CONTRACTOR MUST DEMONSTRATE THIS TO THE OWNER'S AND THE MECHANICAL CONTRACTOR'S SATISFACTION.**
 - g. **Reference "Start-Up Report Verification" in the General Provisions Specification.**
 - h. **Control contractor is to set up any OEM unit mounted controller (ie, similar to Lennox Prodigy, to properly mesh with the DDC system that will be installed. Control contractor MUST provide a written record of original settings from factory and changes made to settings to make the equipment mesh with the DDC system. Include these setting changes in "as built" control drawings.**
 - i. **Any time equipment being installed requires a separate, dry contact to be opened/closed to tell its' internal controller whether it is in an unoccupied or occupied mode, the Control Contractor must provide it. If unit has a factory jumper wire where this dry contact goes, the factory jumper must be removed.**

- j. **Controls Contractor to provide equipment points lists from equipment manufacturer with points highlighted to insure coordination with control submittal.**
- k. **Contractor shall complete ALL Start-up, Contractor Readiness and Commissioning Forms.**
- l. **Contractor to complete all items identified in the Commissioning Report.**
- m. **Contractor Readiness forms are to be fully completed for each piece of equipment and signed off by completing technician prior to calling for final inspection.**

3.02 INSTALLATION

- A. Fasten all equipment securely to structure. Install equipment and conduit parallel to building lines, plumb and level.
- B. Fasten conduit 5'-0" on centers where exposed; on 10'-0" maximum centers where concealed.
- C. ROUTE CONDUIT TO BE OUT OF ACCESS WAYS, AND IN MANNER NOT INTERFERING WITH SERVICE OF EQUIPMENT.
- D. All control and interlock wiring shall comply with the national and local electrical codes and Division 16 of these specifications. Where the requirements of this section differ with those in Division 16, the requirements of this section shall take precedence.
- E. Where Class 2 wires are in concealed and accessible locations including ceiling return air plenums, approved cables not in raceway may be used provided that circuits meet NEC Class 2 (current-limited) requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.)
- F. All cables shall be UL listed for application, i.e., cables used in ceiling plenums shall be UL listed specifically for that purpose.
- G. Do not install Class 2 wiring in conduit containing Class 1 wiring. Boxes and panels containing high voltage may not be used for low voltage wiring except for the purpose of interfacing the two (e.g. relays and transformers).
- H. Where class 2 wiring is run exposed, wiring shall be run parallel along a surface or perpendicular to it, and bundled, using approved wire ties at no greater than 3 m [10 ft] intervals. Such bundled cable shall be fastened to the structure, using specified fasteners, at 1.5 m [5 ft] intervals or more often to achieve a neat and workmanlike result.
- I. All wire-to-device connections shall be made at a terminal blocks or terminal strip. All wire-to-wire connections shall be at a terminal block, or with a crimped connector. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
- J. Maximum allowable voltage for control wiring shall be 120V. If only higher voltages are available, the Control System Contractor shall provide step down transformers.
- K. All wiring shall be installed as continuous lengths, where possible. Any required splices shall be made only within an approved junction box or other approved protective device.

- L. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations in accordance with other sections of this specification and local codes.
- M. Size of conduit and size and type of wire shall be the design responsibility of the Control System Contractor, in keeping with the manufacturer's recommendation and NEC.
- N. Control and status relays are to be located in designated enclosures only. These relays may also be located within packaged equipment control panel enclosures. These relays shall not be located within Class 1 starter enclosures.
- O. Follow manufacturer's installation recommendations for all communication and network cabling. Network or communication cabling shall be run separately from other wiring.
- P. Adhere to Division 16 requirements for installation of raceway.
- Q. This Contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.
- R. Flexible metal conduits and liquid-tight, flexible metal conduits shall not exceed 3' in length and shall be supported at each end. Flexible metal conduit less than 1/2" electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal conduits shall be used.

3.03 PROTECTION

- A. The Contractor shall protect all work and material from damage by his/her work or workers, and shall be liable for all damage thus caused.
- B. The Contractor shall be responsible for his/her work and equipment until finally inspected, tested, and accepted. The Contractor shall protect his/her work against theft or damage, and shall carefully store material and equipment received on site that is not immediately installed. The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.04 CENTRAL SERVER INSTALLATION

- A. The system installer shall perform complete installation and configuration of the following:
 - 1. Server hardware
 - 2. Server operating system
 - 3. Server database software
 - 4. Server application software

3.05 INSTALLATION OF SENSORS

- A. Install sensors in accordance with the manufacturer's recommendations.
- B. Mount sensors rigidly and adequate for the environment within which the sensor operates.
- C. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.

- D. All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor readings.
- E. Install duct static pressure tap with tube end facing directly down-stream of air flow.
- F. Sensors used in mixing plenums, and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.
- G. All pipe mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat conducting fluid in thermal wells.
- H. Wiring for space sensors shall be concealed in building walls. EMT conduit is acceptable within mechanical and service rooms.
- I. Install outdoor air temperature sensors on north wall complete with sun shield at designated location.
- J. Use Velcro straps for tying wires, no zip ties allow.
- K. Any sensor installed in a manner that causes it to be inaccurate or not dependable shall be properly installed and replaced if necessary.
- L. All sensors located in the locker rooms, gym, corridors and other areas of potential abuse are to be protected with suitable heavy duty metal locking covers. Provide Owner with 10 sets of keys.

3.06 PROGRAMMING

- A. Provide sufficient internal memory for the specified control sequences and trend logging. There shall be a minimum of 25% of available memory in building controllers free for future use.
- B. Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index.
- C. Software Programming
 - 1. Provide programming for the system as written in the specifications and adhere to the sequence strategies provided. All other system programming necessary for the operation of the system but not specified in this document shall also be provided by the Control System Contractor. Imbed into any custom-written control programs sufficient comment statements or inherent flow diagrams to clearly describe each section of the program. The comment statements shall reflect the language used in the sequence of operations.
- D. Operators' Interface
 - 1. The controls contractor shall provide all the labor necessary to install, initialize, start-up, and trouble-shoot all operator interface software and their functions as described in this section. This includes any operating system software, the operator interface database, and any third-party software installation and integration required for successful operation of the operator interface.
 - 2. As part of this execution phase, the controls contractor will perform a complete test of the operator interface. Test duration shall be a minimum of 16 hours on-site. Tests shall be made in the presence of the Owner or Owner's representative.

- E. Demonstration: A complete demonstration and readout of the capabilities of the monitoring and control system shall be performed. The contractor shall dedicate a minimum of 16 hours on-site with the Owner and his representatives for a complete functional demonstration of all the system requirements. This demonstration constitutes a joint acceptance inspection, and permits acceptance of the delivered system for on-line operation.

3.07 SEQUENCE OF OPERATION

- A. Clearly write the "Sequence of Operation" in narrative form easily recognized as the sequence specified. Provide complete control systems operating with the following sequences:
- B. Scheduling Groups: a group of units on the same schedule. Groups shall be allowed to have different: schedules and setpoints for ALL modes of operation.
 - 1. Office – minimum number or groups.
 - a. By Tenant
- C. Modes of Operation:
 - 1. Unoccupied/After Hours – the period of the for use of set-back temperatures, No Outside Air available. Building is typically not in use.
 - 2. Occupied – Time of day Occupied Temperatures are required. OA dampers on RTU are allowed on during this time, as described in RTU section only. Outside Air Machines are NOT scheduled by this schedule.
 - 3. Outside Air Schedule – The time of day when Outside Air is allowed to be on. MAU machines are on this schedule. OA dampers on RTU are allowed on during this time. This time is shorter than Occupied. All Outside Air equipment is schedule by this mode. OA machines are not allowed to be scheduled with Occupied Mode.
 - 4. Override – When Override button is pushed during Unoccupied to allow Occupied Temperatures. No Outside Air allowed.
 - 5. If multiple Unoccupied time frames are required to accomplish modes then provide as many as required.
 - 6. Verify final time/temperature setpoints with Owner for final scheduling.
 - 7. Optimum Start, Morning warm-up/Cool-down, Smart Start - Controls to energize units to allow space to reach Occupied setpoint by Occupied schedule time. Unit to energize min 30min before occupied up to 60 min prior. Provide heavy equipment delay start to prevent simultaneous starting of HVAC equipment. If space temperature is satisfied before occupied mode begins, unit is to cycle off. **NO OUTSIDE AIR ALLOWED DURING THIS MODE.**
 - 8. Slide adjustment to be active only during occupied mode.
- D. RTU/AHU (DX):
 - 1. Unoccupied/After Hours Mode
 - a. Unit cycles to maintain Set Back temperatures (reference table for temps.

- b. Outside Air disabled if part of unit control.
 - c. Send an alarm if any humidity sensor exceeds 70% RH (adjustable by Owner).
2. Occupied Mode:
- a. Unit Cycles to Maintain Occupied Temperature(reference table for temps), for Multi-speed units start on low fan - low cool/heat, then if temp not met switch to high fan – high cool/heat. Then as set point is reached ramp down to low fan – low cool/heat in same manner. Timing to be per manufacturer’s recommendations.
 - b. User adjustable offsets of +/- 2degrees, coordinate final offset with owner.
 - c. Outside Air control –
 - 1) Factory mounted OA damper – follow CO2 Control.
 - 2) Non Factory Mounted OA Damper – follow CO2 control, Damper to remain closed except during Outside Air Schedule
 - d. Humidity Control – When unit is equipped with Hot Gas Reheat, “Dry Mode” or other Humidity control option. Humidity sensor shall be placed in space being serviced. Unit to maintain Humidity setpoint based on Humidity Control Sequence. Send an alarm if any humidity sensor exceeds 70% RH (adjustable by Owner).
 - e. Fan set to cycle with call for cooling/heating. Fan should not run unless actively cooling or heating.
3. Outside Air Schedule Mode –
- a. Unit with OA damper follow CO2 Operation Sequence during this time
4. Override – unit sensor is equipped with override button. When button is pressed during Unoccupied/After Hours Mode. Unit changes to Occupied Set points for Owner Selectable amount of time. (typically 1 hour, confirm with owner. (OA disable during this mode.)
5. Morning Cooldown/Warm-Up: See mode.
6. Humidity Control Sequence:
- a. Rooftop Units With Hot Gas Reheat:
 - 1) During occupied mode when building humidity exceeds 60% RH (adjustable) and no call for sensible heating or cooling exists, the humidistat will override the thermostat and bring on the first stage of cooling and simultaneously energize the solenoid valve that activates the hot gas reheat coil to prevent the space from over cooling. On a call for sensible space cooling or heating or when space humidity drops to below 5% below humidistat setpoint, normal operation is to resume. Dehumidification is to be locked out if space temperature falls over 2°F below cooling setpoint.

- b. Units without Hot Gas Re-Heat: Humidity Control Sequence
 - 1) Dry Mode: RH call only, no cooling or heating call: During occupied mode when building humidity exceeds 60% RH (adjustable) and no call for sensible heating or cooling exists, the humidistat will override the thermostat and bring on humidity control sequence to bring down humidity and attempt to prevent the space from over cooling. Lower discharge air to 50 degrees, reduce cfm to 50% design, continue running until humidity request is met. If this operation fails after 2 attempts, send alarm. When space humidity drops to below 5% below humidistat setpoint, normal operation is to resume. Dehumidification is to be locked out if space temperature falls over 2°F below cooling setpoint.
 - 2) RH call and Cooling call: Lower discharge air to 50 degrees, maintain cfm, continue running until cooling request is met, then switch to Drymode to resolve RH. When space humidity drops to below 5% below humidistat setpoint, normal operation is to resume.
 - 3) If this operation fails after 2 attempts, send alarm.
 - c. Library Units: Allow Humidity Control Sequence at ALL times.
7. BAS to provide controller for all Units's to perform specified sequences.
8. CO2 Control- OA dampers to operate as follows during occupied mode ONLY.
- a. BAS Contractor to provide CO2 sensors for units as indicated on either mechanical schedule/plans to control OA damper is scheduled on unit.
 - b. Outside air damper is closed when unit is off
 - c. O/A damper is only allowed to open with ALL of the following conditions are met.
 - 1) Unit in Occupied Mode.
 - 2) Call or Cooling or Heating.
 - 3) CO2 level in space is above 1000 ppm(adjustable) for 15 min(adjustable).
 - d. O/A damper minimum setting is closed/shut. (0% open)
 - e. Reference mechanical schedule notes for additional information on specific units for (CO2/OA).
 - f. **Only open damper when there is a cooling or heating call.**
 - g. Reference equipment Schedules for which units require CO2.
9. Economizer Function – When a unit is equipped with an economizer, due to climate zone humidity of site. Economizer shall be set to operate as follows:
- a. Dry Bulb: Set to operate at 55 degrees drybulb and below only. No other setting is allowed.
 - b. Enthalpy Setting – not allowed.

- c. Economizer target discharge air temperature – 55 degrees
 - d. Economizer Min Setting – shall be 0%. (IE: closed)
 - e. An Economizer module is **NOT** allowed to be used by unit manufacture to provide OA damper operations for CO2 control.
- E. MAKE-UP AIR UNIT – (MAU/HRU) CONTROL:
- 1. Unoccupied/After Hours / Override – MAU unit shall be disabled.
 - 2. Occupied Mode – Unit shall be disabled and only enabled on Outside Air Schedule Mode.
 - 3. Outside Air Schedule Mode: MAU/OA to operate as follows **ONLY** during Outside Air Schedule Mode. Internal Factory Make-up air Unit controls are to cycle cooling/heating and hot gas reheat maintain coil temperature and supply air discharge temperature based on temperature OA temp setpoint from BAS system. During Reheat Mode / Dehumidification Mode Coil Temperature and Discharge Air Temperature are different (coil temp must be maintained at 52-55 degrees) Discharge Air is to be requested by BAS.
 - a. Below 55degrees – unit heats to approx. 70-72 degree SA (Adjustable)
 - b. 55 – 80degrees – unit cools to 52-55 degrees off cooling coil, then Hot Gas Reheat to discharge supply air temp of 70– 72 degrees. (Adjustable)
 - c. Above 80 degrees – unit supply air is 52-55 degrees. (Adjustable)
 - d. BAS to send input to appropriate MAU BACnet points. **Controls contractor to coordinate with equipment manufacturer for points list.**
 - e. **ALL TEMPS LISTED ARE TO BE ADJUSTABLE.**
 - 4. Controls: DX Equipment manufacturer is to provide factory stand-alone programmable direct digital control system and completely wire MAU for operation in all modes of operation. Provide connections suitable for switching from occupied to unoccupied modes. **Unit controller to be BACnet IP compatible for allowing interface with Building Automation System (BAS). Chilled water units control contractor to provide ALL controllers required to meet sequence.**
 - 5. The Controls Contractor is required to send all required provide controller for signal to MAU for activation of all modes of operation. Monitor the following points: in addition to points on sample graphics and points listed elsewhere in specification. Controls Contractor is required to provide controller and sensors to get any information not available from Unit manufacture through BacNet.
 - a. Outside Air Temperature and Humidity at Inlet.
 - b. Outside Air Temperature Downstream of final Cooling Coil and ahead of Heat Section.
 - c. Supply Air Temperature and Humidity Downstream of Heat Section and Blower.
 - d. Provide logic that will show alarm and shut MAU unit off if after 20 minutes of run time if the discharge air temperature fall outside of acceptable limits when outside air temperature is above 55 degrees and cooling coil temp is above 60 degrees.

Calculate if necessary. Control system to notify Owner that unit needs to be physically checked to ensure that untreated or improperly treated outside air does not damage the building before reset. (The controls contactor is to send a signal to the Unit controller to shut down unit when temperatures are outside the ranges listed above).

- F. Water Heaters:
1. Provided with factory controls to maintain temperature.
 2. Provide Controls Points to operate domestic hot water circulation pumps to run on schedule decided by owner. Control by building energy management system.
- G. Unit Heaters: Control by wall thermostat.
- H. Exhaust Fan Control:
1. For control of fans, reference the Fan Schedule on drawing. Control Contractor to control fan when required by Exhaust Fan Schedule.
 2. Provide graphic display on BAS as to mode/current status of ALL KSF - kitchen supply and KEF – kitchen exhaust fans. Provide components required to monitor.
 3. Exhaust fans controlled by motion sensor are not required to be controlled by BAS.
- I. VRV/VRF Units
1. Reference VRF Control Specification(23 70 70) for additional information.
 2. BAS to integrate with VRV/VRF Systems through VRF integration pane with BACnet for scheduling and setpoint for space temperature.
 3. BAS to also provide controllers and duct mounted temperature sensor to monitor discharge air temperature. Mount sensor approximately five feet downstream of unit in accessible location. Provide humidistat above each thermostat. Humidistat to energize AHU “Dry Mode” whenever humidity exceeds 60% RH (adjustable by Owner).
 - a. Controls: VRF Equipment manufacturer is to provide factory stand-alone programmable Direct Digital Control System and completely wire outside air unit for operation in all modes of operation. Provide connections suitable for switching from occupied to unoccupied modes. **Unit controller to be BACnet MSTP compatible for allowing interface with Building Automation System (BAS).**
 - b. **VRF MAU to follow MAU control sequence below U.O.N.**
- J. VRV/VRF Units (Stand Alone Option – no BacNet – individual heat pumps)
1. Stand Alone VRF Heat Pumps with Factory T-stat.
 2. **Provide 3rd PARTY DDC T-STAT INTEGRATION:**
 - a. **PROVIDE DKN PLUS INTERFACE “AIRZONE PART# AZAI6WSPDKC”, or equal.**

- b. **Provide DDC Sensor with Temp and RH to match district standard. Connect DDC sensor to interface module.**
 - c. **Move Existing Unit manufacture sensor above ceiling for future programing and error code reference.**
 - d. **Provide BAS controller for each of these units.**
 - e. **Provide Discharge Air sensor.**
3. BAS to provide controllers and sensors described to provide heating and cooling sequences similar to of the heat pumps on project, as well as duct mounted temperature sensor to monitor discharge air temperature. Mount sensor approximately five feet downstream of unit in accessible location. Provide humidistat above each thermostat. Humidistat to energize AHU "Dry Mode" whenever humidity exceeds 55% RH (adjustable by Owner).
- K. HVAC EMERGENCY SHUTDOWN A: Provide red button mushroom switch located in Administration location by Owner for shutdown of all HVAC equipment except MDF and IDF rooms. Provide hinged plastic protective cover. Label switch. Provide hinged plastic protective cover with local alarm. Label switch.
- L. HVAC EMERGENCY SHUTDOWN B: Fire Alarm to provide signal to DDC for shutdown of all HVAC equipment. Coordinate with Fire Marshal for exception of MDF and IDF rooms.
- M. Lighting Control: Reference electrical drawings for additional requirements. Provide components required for control of exterior lighting. Usually control of Lighting contactor, coordinate with electrician for exact components coordination. (confirm No relay panels)
- N. Power Monitoring System
- 1. Controls Contractor to provide power monitoring for electrical system as described on electrical plans on "Power Monitoring Schedule". The power monitoring system is to allow the Owner to easily monitor and collect critical data on lighting, receptacle and HVAC kwh consumption in the building. The data will allow the Owner to monitor energy usage and schedule the building for optimum energy usage.
 - 2. The Controls Contractor shall provide all materials, labor and software for complete workable system. This includes but is not limited to CT's, controllers, low voltage wiring, cabling, and provide all programming for power monitoring system. Coordinate with electrical contractor when installing CT's in electric panels. BAS Contractor to provide and install all CT's.
 - 3. BAS Contractor to provide energy software to allow for graphical display and reporting of collected energy consumption data. Minimum displaying of data:
 - a. Bar graph/pie chart/line graph display of collected data for individual CT or any combination of CT's, in KW and KWH form.
 - b. Software to allow for energy data to be easily selectable over time by date, hour, today, last 24 hours, this week, this month, this year, for displaying data.
 - c. Software to allow for multiple comparisons in graphical forms.
 - 1) Multiple buildings.

- 2) Multiple time frames.
 - a) Energy over time (line graph)
 - b) Cumulative energy use for time frame (bar graph)
 - Total electric energy
 - HVAC
 - Lighting
 - Receptacle
 - Total energy (including gas same (energy units)
 - Any other breakout on Power Monitoring Schedule
- 3) Energy units to be selectable.
 - a) KW/KWH
 - b) BTU
- d. Display EUI (Energy Utilization Index) in BTUh/Sq Ft – year (gas and electric.)
- e. GAS Monitoring: (Verify final location with Owner)
 - 1) Display and organize gas data with same functionality as Electric (whether measured or input from utility bill). All display energy units to be selectable.
 - 2) Provide an additional gas meter or provide a gas meter to measure gas usage to entire building.
 - 3) Provide additional gas meter to break out kitchen gas usage. Size based on plans. If no size is specified assume xxxxx BTU's for Basis of Design.
- f. Water Monitoring: (Verify final location with Owner)
 - 1) Display and organize water data with same functionality as Electric (whether measured or input from utility bill). All display energy units to be selectable.
 - 2) Provide an additional water meter to measure water usage to entire building.
4. Provide ability to add new buildings.
 - a. Manual input of monthly data.
 - b. Auto input from future Owner provided devices.

5. Submit output sheet/graphic indicating requested energy data as indicated on drawings and specifications for Owner and Engineer review.

END OF SECTION

ATTACHMENT 4

The screenshot displays a control interface for an Air Handling Unit (AHU_07) in Classroom 313. The interface includes a navigation bar with 'Back' and 'Home' buttons. The main display area shows the unit's name and room name, along with various operational parameters and controls. The interface is annotated with 20 numbered callouts:

- 1. EQUIPMENT NUMBER/ROOM NAME: Points to the unit name 'AHU_07 Classroom 313'.
- 2. LINK TO SCHEDULE: Points to a link icon next to the 'Occupied Status' dropdown.
- 3. O/A INFO AND TIME AND DATE MISSING: Points to the 'Outside Air' section.
- 4. LINK TO ZONE TEMP GRAPH: Points to a link icon next to the 'Supply Temp' value.
- 5. OCCUPIED STATUS: Points to the 'Occupied' status in the dropdown menu.
- 6. COOLING STAGES: Points to the 'Stage 1' and 'Stage 2' controls under the 'Compressor' section.
- 7. ELECTRIC REHEAT: Points to the 'Unit Heater' control.
- 8. FAN STATUS: Points to the 'Status' control under the 'Supply Fan' section.
- 9. (Unlabeled): Points to the 'Return Air' section.
- 10. DISCHARGE AIR TEMP: Points to the 'Supply Temp' value of 60.5 °F.
- 11. OCCUPIED TEMP RANGE: Points to the 'Occupied Cooling Setpoint' of 72.0 °F.
- 12. UNOCCUPIED TEMP RANGE: Points to the 'Occupied Heating Setpoint' of 68.0 °F.
- 13. (Unlabeled): Points to the 'Hardware Config Page' button.
- 14. ACTUAL SPACE TEMP: Points to the 'Room Temperature' of 68.0 °F.
- 15. OVERRIDE BUTTON: Points to a small circular button next to the 'Room Temperature' value.
- 16. SPACE TEMP SET POINT ADJUSTMENT: Points to the 'Active Cooling Setpoint' of 69.0 °F.
- 17. ADJUSTED SET POINTS: Points to the 'Active Heating Setpoint' of 65.0 °F.
- 18. (Unlabeled): Points to the 'Local Setpoint Adjust' of -3.0 °F.
- 19. (Unlabeled): Points to the 'Unit Heater' control.
- 20. UNIT HAS O/A MEASURED: Points to the 'Outside Air' section.

The interface also features a 3D schematic of the AHU components: Outside Air, DX Coil, Supply Fan, Electric Reheat, and Supply Air. The 'Setpoints' section shows 'Occupied Cooling Setpoint' at 72.0 °F and 'Occupied Heating Setpoint' at 68.0 °F. The 'Space Conditions' section shows 'Room Temperature' at 68.0 °F, 'Active Cooling Setpoint' at 69.0 °F, 'Active Heating Setpoint' at 65.0 °F, and 'Local Setpoint Adjust' at -3.0 °F. The 'Supply Fan' status is 'On', and the 'Unit Heater' command is 'Disable'.

RTU GRAPHIC TYP



ROD-RTU-C121

2. LINK BUTTON TO UNIT SCHEDULE

1. EQUIPMENT NUMBER AND CLASSROOM NUMBER

3. OUTSIDE AIR TEMP AND RH, MISSING CURRENT DATE AND TIME

Occupied

5. OCCUPANCY MODE

Ventilation

21. HVAC MODE

6. COOLING STAGES

7. HOT GAS REHEAT

9. HEATING STAGES

0 %

0 %

2 %

Off 0:0

0 %

20. OUTSIDE AIR/OUTSIDE AIR DAMPER

14. ACTUAL SPACE TEMP

10. DISCHARGE AIR TEMP

74.2 °F

Space Conditions

11. OCCUPIED TEMP RANGE

8. FAN STATUS

74.2 °F

SpC 76.0 °F

Sp 74.0 °F

SpH 72.0 °F

15. OVERRIDE BUTTON OPERATIONAL

16. SPACE TEMP SET POINT ADJUSTMENT

52 %RH

CO2 774 PPM

18. CO2 LEVEL/SET POINT

Sp 55 %RH

Sp 1100 PPM

19. RH LEVEL/SET POINT

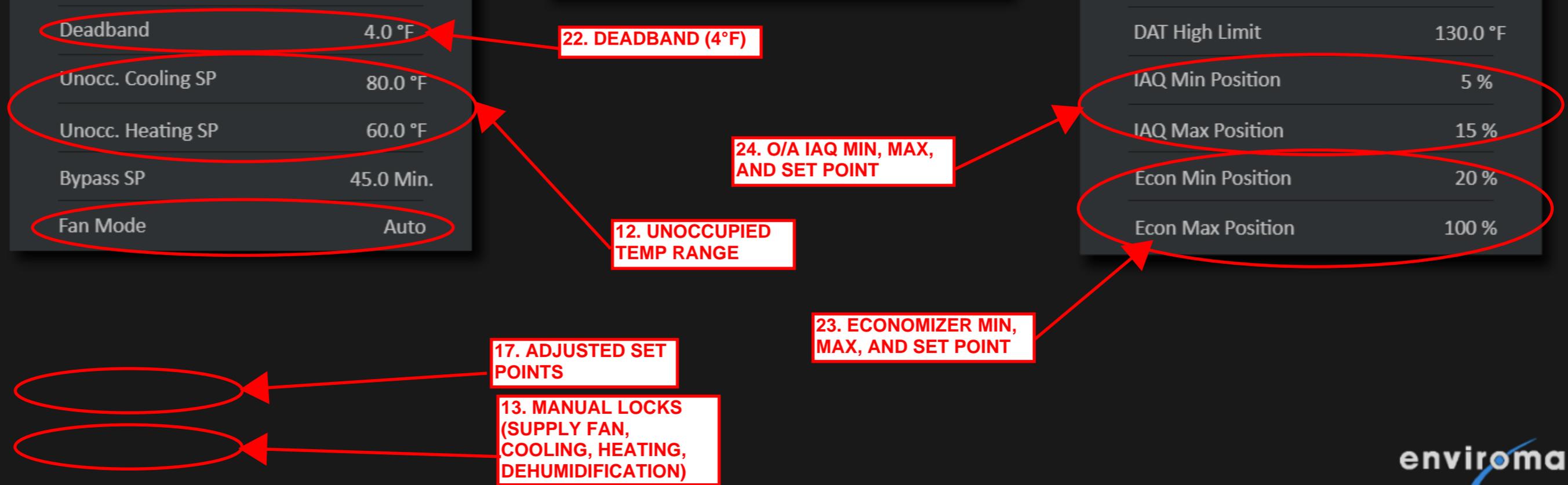
ATTACHMENT 4

TEMPERATURE CONFIGURATION	
Setpoint	74.0 °F
Min Setpoint	70.0 °F
Max Setpoint	74.0 °F
Deadband	4.0 °F
Unocc. Cooling SP	80.0 °F
Unocc. Heating SP	60.0 °F
Bypass SP	45.0 Min.
Fan Mode	Auto

TRENDS

Equipment Trend Log

LIMITS	
Cooling Lockout Temp	50.0 °F
Heating Lockout Temp	70.0 °F
DAT Low Limit	40.0 °F
DAT High Limit	130.0 °F
IAQ Min Position	5 %
IAQ Max Position	15 %
Econ Min Position	20 %
Econ Max Position	100 %



ATTACHMENT 4

The screenshot displays a control interface for an RTU unit. At the top, there are navigation buttons for 'Back' and 'Home', followed by the unit identifier 'RTU_01 Upper Gym'. Below this, the 'Occupied Status' is set to 'Occupied', and the 'Fire Alarm' is 'Off'. The 'RTU Mode' is 'Cool Mode', and the 'Supply Temp' is 73.8 °F. The interface shows a 3D rendering of the RTU components: Outside Air, Filter, DX Coil, Supply Fan, Gas Heat, and Supply Air. Below the rendering are control panels for 'Compressor' (Stage 1: Enable, Stage 2: Disable), 'Supply Fan' (Command: Enable, Status: On), and 'Gas Heat' (Stage 1: Disable, Stage 2: Disable). At the bottom, there are sections for 'Occupied Setpoints' (Cool: 69.0 °F, Heat: 65.0 °F), 'Scheduling' (Individual Schedule, Group Schedule, Using Group, Occupied), and 'Room Conditions' (Effective Cool Setpoint: 69.0 °F, Effective Heat Setpoint: 65.0 °F, Room Temp: 68.8 °F). A 'Hardware Config' button is also present.

20. UNIT HAS O/A MEASURED

1. EQUIPMENT NUMBER/ROOM NAME

5. OCCUPIED STATUS

10. DISCHARGE AIR TEMP

4. LINK TO ZONE TEMP GRAPH

13. MANUAL LOCKS

3. O/A INFO AND TIME AND DATE MISSING

9. HEATING STAGES

17. ADJUSTED SET POINTS

6. COOLING STAGES

8. FAN STATUS

11. OCCUPIED TEMP RANGE

14. ACTUAL SPACE TEMP

2. LINK TO SCHEDULE

12. UNOCCUPIED TEMP RANGE

16. SPACE TEMP SET POINT ADJUSTMENT

15. OVERRIDE BUTTON

RTU GRAPHIC TYP

ATTACHMENT 4

CLIMATEC
MERGING BUILDINGS & TECHNOLOGY

07/29/2019 01:58:26 PM
OA Temp 61.0 °F
OA Humidity 85.0 % RH

MISD NTHS RTU-1 Room 118

1. RTU NUMBER AND ROOM NUMBER

2. LINK BUTTON TO SCHEDULES (MISSING)

3. TIME, DATE, O/A TEMP AND %RH (TEMP AND RH NEED TO BE CORRECTED)

4. Command
Fan Status

5. OPERATING MODE

6. COOLING STAGES

7. HOT GAS REHEAT (MISSING)

8. FAN STATUS

9. HEATING STAGES

10. DISCHARGE AIR TEMP TO SPACE

11. OCCUPIED SETPOINT

12. UNOCCUPIED SETPOINTS

13. CO2 SENSOR INFORMATION

14. ACTUAL ROOM TEMP

15. MANUAL OVERRIDE BUTTON

16. SPACE TEMP SET POINT ADJUSTMENT

17. RETURN AIR TEMP

18. ROOM %RH

19. ROOM %RH

20. OUTSIDE AIR

21. RETURN AIR TEMP

22. Supply Temp 60.8 °F

Operating Status

- Occupied
- Warmup
- Cooldown
- Afterhours

Scheduled

Afterhours Timer: 0.0

Fan Mode: 3

- 1 -- Continuous
- 2 -- Cycle Heating Only
- 3 -- Cycle Heating and Cooling

Zone Setpoint

- 72.5 °F Space Temp
- 70 °F Occupied Setpoint
- 44.5 % Space Humidity
- 72.0 °F Occupied Spt Hi Limit
- 70.0 °F Occupied Spt Lo Limit
- 2.0 °F Heating Offset
- 2.0 °F Cooling Offset
- 55 °F Unoccupied Htg
- 85 °F Unoccupied Clg
- 0 % Heating Signal
- 41 % Cooling Signal
- 40 °F Clg Lockout Temp
- 90 °F Htg Lockout Temp

Equip. Runtimes

- 531 hrs Fan Hours
- 531 hrs Filter Hours
- 400 hrs Compressor-1 Hours
- 4,612 Compressor-1 Starts
- 73 hrs Heat Stage-1 Hours

ATTACHMENT 5

The screenshot displays a control interface for a classroom unit. At the top, navigation buttons for 'Back' and 'Home' are visible. The main header shows 'IU_A11 Classroom 113'. Below this, the 'Occupied Status' is set to 'Occupied', and the 'HP Mode' is 'Off'. A 3D cutaway view of the HVAC unit shows components like the Filter, DX Coil, Supply Fan, Electric Reheat, and Supply Air. Below the cutaway, there are controls for the Compressor (Stage 1: Disable, Rev. Valve: Disable), Supply Fan (Command: Disable, Status: On), and Unit Heater (Command: Disable). The bottom section contains three panels: 'Setpoints' (Occupied Cooling: 72.0 °F, Occupied Heating: 68.0 °F, Unoccupied Cooling: 85.0 °F, Unoccupied Heating: 60.0 °F, Fan Cycle Mode: Cycle), 'Space Conditions' (Room Temperature: 73.9 °F, Active Cooling Setpoint: 75.0 °F, Active Heating Setpoint: 71.0 °F, Local Setpoint Adjust: 3.0 °F), and 'Overrides' (Fan Command, Compressor Command, Reversing Valve, and Unit Heater Command, all set to Disable). A 'Hardware Config Page' button is also present.

1. EQUIPMENT AND ROOM NAME

2. LINK TO UNIT SCHEDULE

3. O/A CONDITIONS MISSING

4. LINK TO ZONE TEMP GRAPH

5. OCCUPIED STATUS

6. COMPRESSOR STATUS AND STAGE

7. REVERSING VALVE

8. HEAT PUMP MODE

9. FAN STATUS

10. DISCHARGE AIR TEMP

11. OCCUPIED TEMP RANGE

12. UNOCCUPIED TEMP RANGE

13. O/A CONDITIONS MISSING

14. ACTUAL SPACE TEMP

15. SPACE TEMP SET POINT ADJUSTMENT

16. UNOCCUPIED TEMP RANGE

17. ADJUSTED SET POINTS

IU GRAPHIC TYP

ATTACHMENT 5

CLIMATEC
MERGING BUILDINGS & TECHNOLOGY

07/29/2019 01:52:15 PM
OA Temp 61.0 °F
OA Humidity 85.0 % RH

New Tech High School
MISD NTHS Room 317
Split AC Elect Heat

1. RTU NUMBER AND ROOM NUMBER

2. LINK BUTTON TO SCHEDULES (MISSING)

3. TIME, DATE, O/A TEMP AND %RH (TEMP AND RH NEED TO BE CORRECTED)

4. [Empty Circle]

5. OPERATING MODE

6. COOLING STAGES

7. [Empty Circle]

8. FAN STATUS

9. HEATING STAGES

10. DISCHARGE AIR TEMP TO SPACE

11. OCCUPIED SETPOINT

12. UNOCCUPIED SETPOINTS

13. [Empty Circle]

14. ACTUAL ROOM TEMP

15. MANUAL OVERRIDE BUTTON

16. SETPOINT ADJUSTMENT

17. [Empty Circle]

18. [Empty Circle]

19. ROOM %RH

20. OUTSIDE AIR

ON Fan Command
ON Fan Status

53.7 °F Supply Temp

OFF Heat Stg-1

ON Clg Stg-1

Operating Status

- Occupied
- Scheduled
- Warmup
- Cooldown
- Afterhours
- Afterhours Timer: 0.0
- Disable Unit
- Fan Mode: 3
- 1 -- Continuous
- 2 -- Cycle Heating Only
- 3 -- Cycle Heating and Cooling

Zone Setpoint

- 72.0 °F Space Temp
- 70 °F Occupied Stpt
- 72 °F Occupied Stpt Hi Limit
- 70.0 °F Occupied Stpt Lo Limit
- 2.0 °F Htg Offset
- 2.0 °F Clg Offset
- 55 °F Unoccupied Htg Stpt
- 85 °F Unoccupied Clg Stpt
- 45 °F Clg Lockout Temp
- 70 °F Htg Lockout Temp
- 0 % Htg Signal
- 60 % Clg Signal

Alarms

- Bad Sensor Alarm
- Heating Attained Alarm: 129 °F
- Cooling Attained Alarm: 54 °F
- Space Too Warm Alarm
- Space Too Cold Alarm
- Low Supply Temp Alarm: 45 °F

ATTACHMENT 6

The screenshot displays a control interface for a room labeled "HP_A03 Hall". At the top, there are navigation buttons for "Back" and "Home". The room name "HP_A03 Hall" is prominently displayed, with a "Schedules" button to its right. Below this, the "Plant Enable Parameters" section includes "Plant Ready" (Ready), "Call for Plant" (Disable), "CW Supply Temp" (79.4 °F), and "HP Mode" (Off). To the right, the "Occupied Status" is set to "Occupied", and the "Supply Temp" is 76.8 °F. A 3D visualization of the HVAC system shows "Outside Air", "DX Coil", "Supply Fan", and "Supply Air" components. Below this, the "Compressor" status shows "Stage 1" (Disable) and "Rev. Valve" (Disable). The "Supply Fan" status shows "Command" (Disable) and "Status" (Off). The "Room Conditions" panel shows "Effective Cool Setpoint" (74.7 °F), "Effective Heat Setpoint" (70.7 °F), "Room Temp" (74.2 °F), and a "Room Slider" (2.7 °F). The "Occupied Setpoints" panel shows "Cool Setpoint" (72.0 °F) and "Heat Setpoint" (68.0 °F). The "Scheduling" section includes "Individual Schedule" (Using Group) and "Group Schedule" (Occupied), with a "Hardware Config" button below. A "Return Air" indicator is also visible.

1. EQUIPMENT AND ROOM NAME

2. LINK TO SCHEDULES

3. O/A CONDITIONS MISSING

4. HEAT PUMP MODE

5. OCCUPIED STATUS

6. COMPRESSOR STATUS AND STAGE

7. REVERSING VALVE

8. HEAT PUMP MODE

9. FAN STATUS

10. DISCHARGE AIR TEMP

11. OCCUPIED TEMP RANGE

12. CONDENSOR WATER SUPPLY TEMP

13. ADJUSTED SET POINTS

14. ACTUAL SPACE TEMP

15. SPACE TEMP SET POINT ADJUSTMENT

16. RETURN AIR

17. ADJUSTED SET POINTS

18. SUPPLY AIR

19. CONDENSOR WATER SUPPLY TEMP

AREA FLOOR PLAN TYP

ATTACHMENT 6

CLIMATEC
MERGING BLUE PRINT & TECHNOLOGY

D185
MISD NTHS_BLDG-D FCU-4 (D185)

Schedule 7:00am - 9:00pm
Schedule ON

07/29/2019 02:10:47 PM
OA Temp 61.0 °F
OA Humidity 85.0 % RH

Split AC - NG Heat, OA Only

ON Fan Command

8. FAN STATUS

1. RTU NUMBER AND ROOM NUMBER

2. EQUIPMENT SCHEDULES

10. DISCHARGE AIR TEMP TO SPACE

68.8 °F Supply Temp

3. TIME, DATE, O/A TEMP AND %RH (TEMP AND RH NEED TO BE CORRECTED)

20. OUTSIDE AIR

OA Damper

OFF Heat Stg-1
OFF Heat Stg-2

9. HEATING STAGES

ON Clg Stg-1

6. COOLING STAGES

5. OPERATING MODE

14. ACTUAL ROOM TEMP

Operating Status

- Occupied
- Scheduled
- Warmup
- Cooldown
- Afterhours
- Afterhours Timer: 0.0
- Disable Unit
- Fan Mode: 3
- 1 -- Continuous
- 2 -- Cycle Heating Only
- 3 -- Cycle Heating and Cooling

15. MANUAL OVERRIDE BUTTON

11. OCCUPIED SETPOINT

Zone Setpoint

- 74.0 °F Space Temp
- 68 °F Space Temp Setpoint
- 72.0 °F Supply Stpt Hi Limit
- 68.0 °F Supply Stpt Lo Limit
- 2.0 °F Htg Offset
- 2.0 °F Clg Offset
- 60 °F Unoccupied Htg Stpt
- 80 °F Unoccupied Clg Stpt
- 40 °F Clg Lockout Temp
- 80 °F Htg Lockout Temp
- 0 % Htg Signal
- 100 % Clg Signal

19. ROOM %RH

16. SETPOINT ADJUSTMENT

Alarms

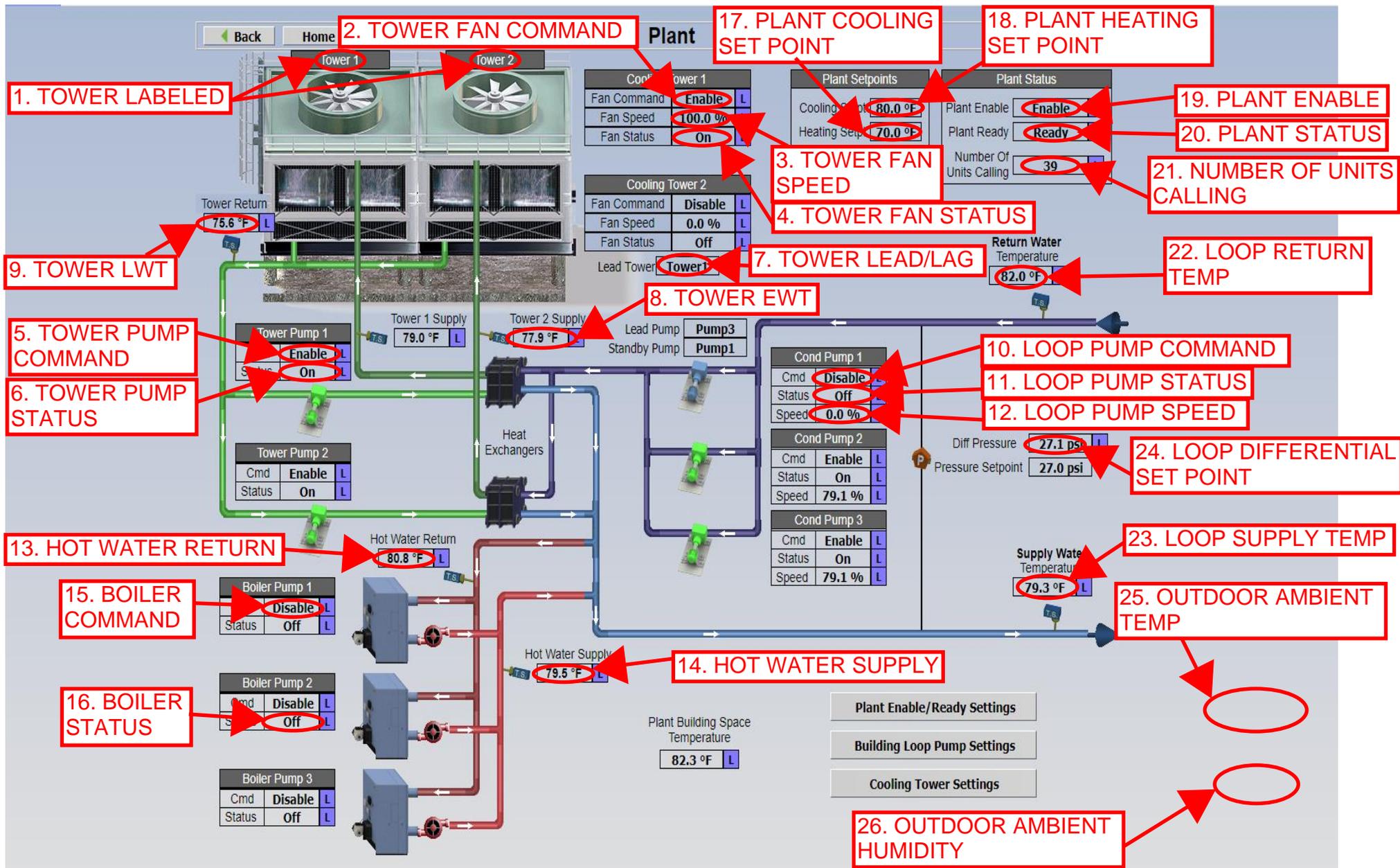
- Heating Attained Alarm: 77 °F
- Cooling Attained Alarm: 69 °F
- Low Supply Temp Alarm: 40 °F

12. UNOCCUPIED SETPOINTS

Runtimes

- 1,243 hrs Fan
- 1,243 hrs Filter **ALARM**
- 0 hrs Filter Runtime
- Alarm Setpoint
- 454 hrs Compressor-1 Hours
- 3,208 Compressor-1 Starts

ATTACHMENT 7



PLANT GRAPHIC

Area A (300 / Front Offices/ Library)

10. AREA NAME INDICATED.

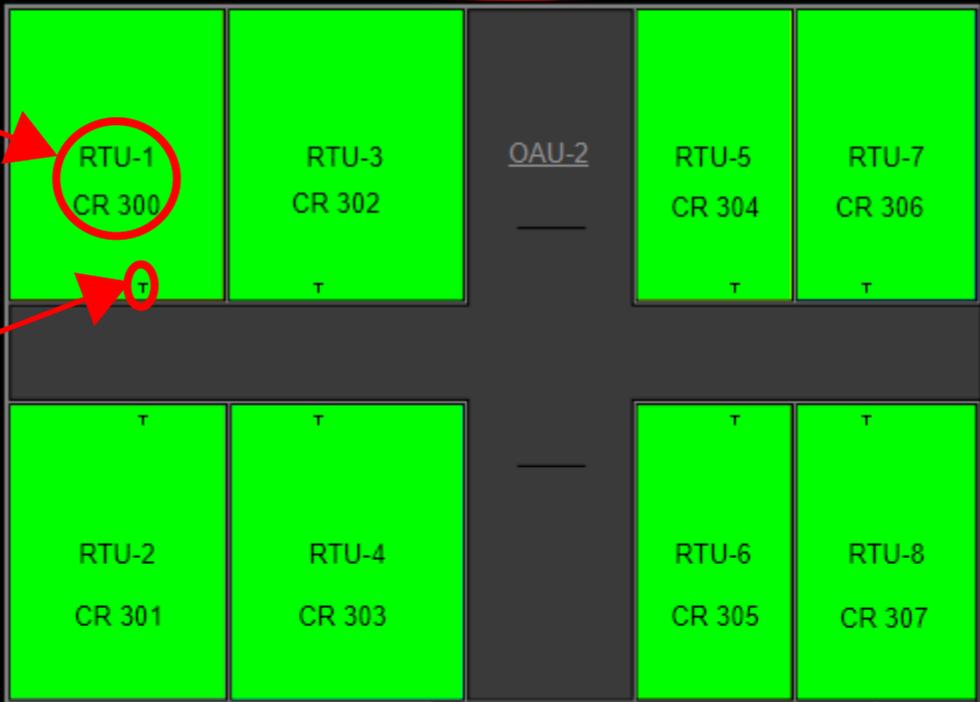
39.3 °F
80.8 %rh

11:23 AM
2/28/2019 Thursday



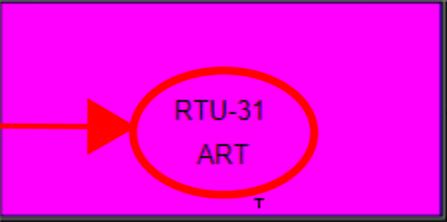
14. EMERGENCY SHUTDOWN BUTTON INDICATED.

11. ROOM NAME AND NUMBER INDICATED.



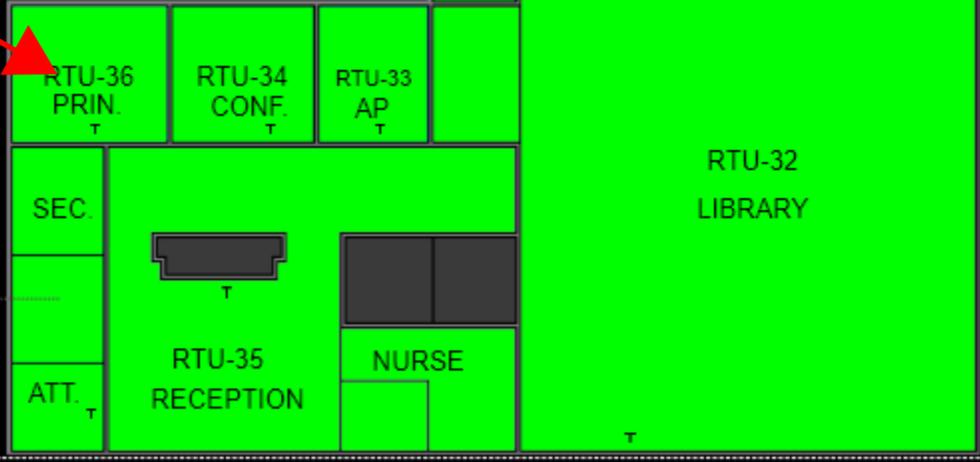
12. THERMOSTAT LOCATED AND INDICATED.

13. EQUIPMENT DESIGNATION/NUMBER.



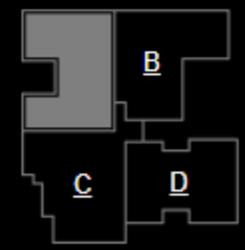
9. AREA PLAN

15. LINK BUTTON TO EQUIPMENT



ATTACHMENT #3: AREA 'A' TYPICAL AREA GRAPHIC.

ATTACHMENT 3: TYP AREA GRAPHIC



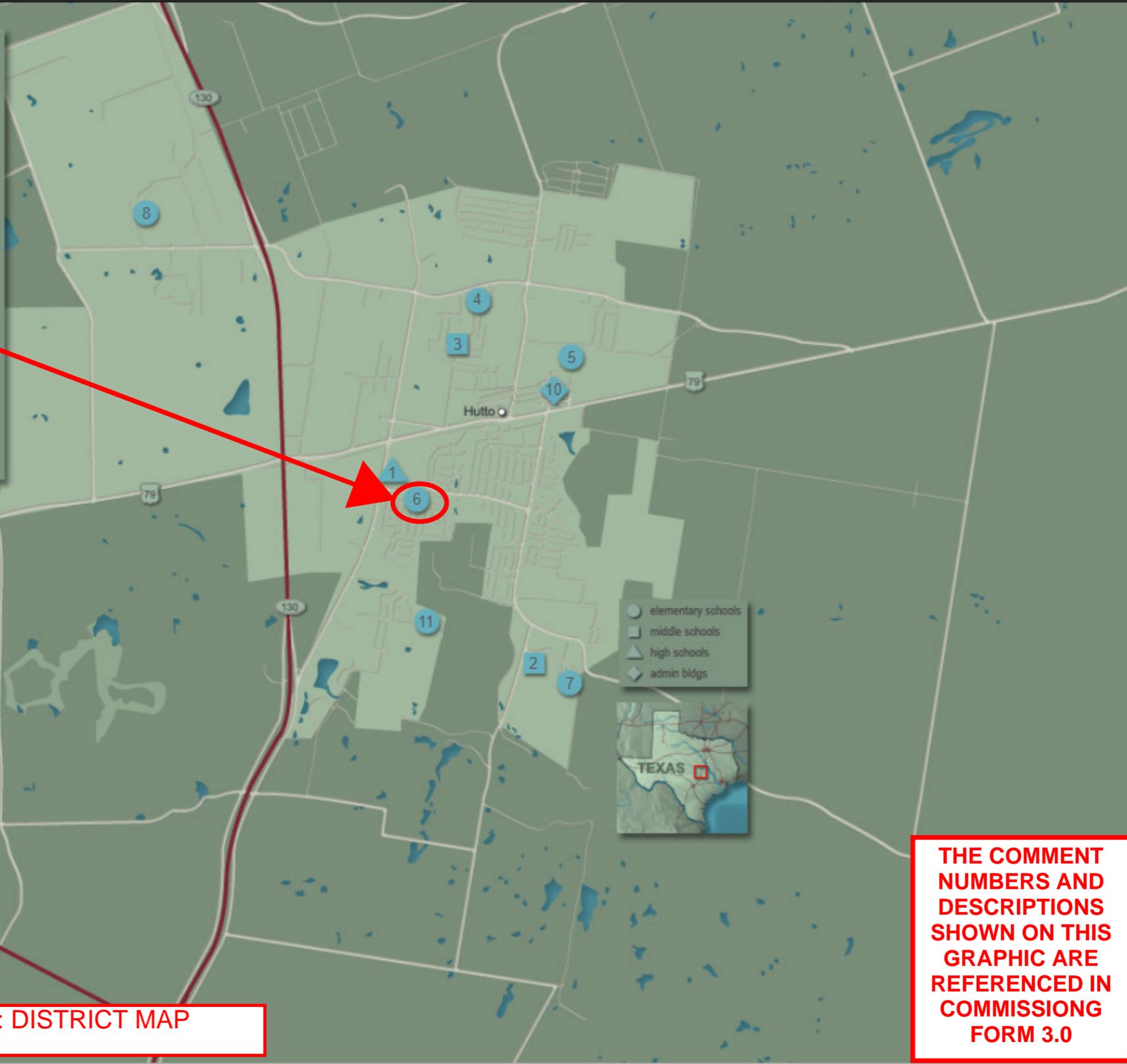
THE COMMENT NUMBERS AND DESCRIPTIONS SHOWN ON THIS GRAPHIC ARE REFERENCED IN COMMISSIONING FORM 3.0

2. CURRENT DATE AND TIME.



- High Schools
1. Hutto High
- Middle Schools
2. Farley Middle
3. Hutto Middle
- Elementary Schools
4. Cottonwood Creek
5. Hutto ES
6. Nadine Johnson
7. Ray ES
8. Veteran's Hill
11. Howard Norman
- Administrative
9. Support Service
10. IT Network Ctr

1. SCHOOL SHOWN ON DISTRICT MAP.



ATTACHMENT 1: DISTRICT MAP

THE COMMENT NUMBERS AND DESCRIPTIONS SHOWN ON THIS GRAPHIC ARE REFERENCED IN COMMISSIONG FORM 3.0

4. OVERALL FLOOR PLAN NAME

Nadine Johnson ES

7. CURRENT DATE AND TIME.

39.2 °F
80.4 %rh

5. OUTSIDE AIR TEMP AND RH.

11:20 AM
2/28/2019 Thursday



Normal

*Point Wired to RTU -34



3. OVERALL FLOOR PLAN.

Fresh Air Status	
MAU 1	Off 0 cfm
MAU 2	Off 0 cfm
MAU 3	Off 0 cfm
MAU 4	Off 0 cfm
MAU 5	Off 0 cfm

8. FREEZER AND COOLER INFORMATION WITH HOT LINK.

Freezer Temp 6.5 °F
Cooler Temp 38.0 °F

alarm cooler cool ideal warm warmer alarm on off

ATTACHMENT 2: OVERALL FLOOR PLAN



THE COMMENT NUMBERS AND DESCRIPTIONS SHOWN ON THIS GRAPHIC ARE REFERENCED IN COMMISSIONING FORM 3.0

OAU-2

60.8 °F
79.6 %h
12:25 PM
2/28/2019 Thursday

3. OUTSIDE AIR TEMP, RH, TIME, AND DATE

2. LINK BUTTON OPERATIONAL

OAU-2
Status Normal

1. EQUIPMENT NUMBER

To: Summary
Supply temp setpoint based on O/A temp
Discharge Air Setpoint 71.0 °F
Occupied/Unoccupied Unoccupied

11. DISCHARGE AIR SET POINT

0 %Open

12. POSITION OF OUTSIDE AIR DAMPER

5. COOLING STAGE(S)

Stage 1 Off
Stage 2 Off

6. DISCHARGE AIR TEMP OFF COOLING COIL

9. HEATING STAGE(S)

14. INCLUDE CFM SETPOINT

13. UNIT AIR FLOW (CFM)



64.9 °F

7. HOT GAS REHEAT

100 HGR %

8. FAN STATUS

s/s Off
status Off
rfd speed 0 %

0 %open

66.5 °F

0 CFM

10. DISCHARGE AIR TEMP TO SPACE

unit status
Start/Stop command Off
Start/Stop Status Off
Occupancy Status Unoccupied

4. UNIT STATUS

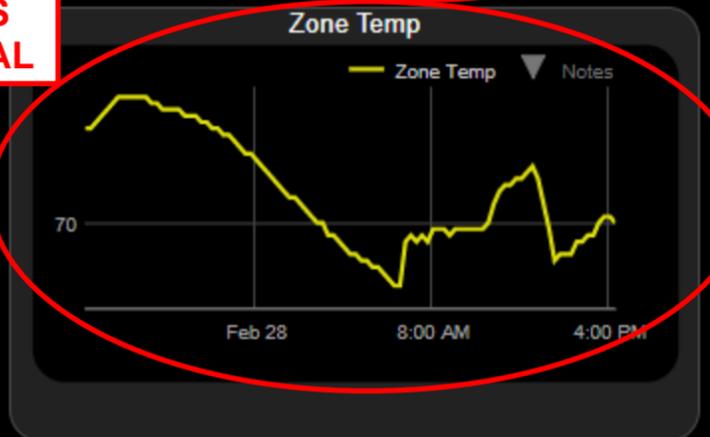
3. OUTSIDE AIR TEMP, RH, TIME, AND DATE

42.8 °F
74 %rh
1:06 PM
2/27/2019 Wednesday

2. LINK BUTTON TO SCHEDULES IS OPERATIONAL

RTU-42 Cafe-East
Status Normal

1. EQUIPMENT AND ROOM LABELED



4. ZONE TEMP GRAPH

5. MODE OF OPERATION

Unit is currently in: **Occupied Mode**

10. DISCHARGE AIR TEMP

69.0 °F

20. UNIT HAS OUTSIDE AIR MEASURED.

46 %Open

Manual Locks

SF Off

DX-1 Off

DX-2 Off

GH-1 Off

GH-2 Off

*Dehumid Mode Off

OCC Unoccupied

*Zone temperature must be satisfied for dehumidification mode to operate.

13. MANUAL LOCKS INDICATED



7. HOT GAS REHEAT

9. HEATING STAGE(S) INDICATED



14. ACTUAL SPACE TEMP

15. OVERRIDE BUTTON

6. COOLING STAGE(S) INDICATED

18. CO2 AND CO2 SET POINT

CO2 level 926 ppm

CO2 setpt 1100 ppm

RH level 45 %

RH setpt 60 %

setpoint adjusted by +0.0 °F

effective cool setpt 74.0 °F

effective heat setpt 65.0 °F

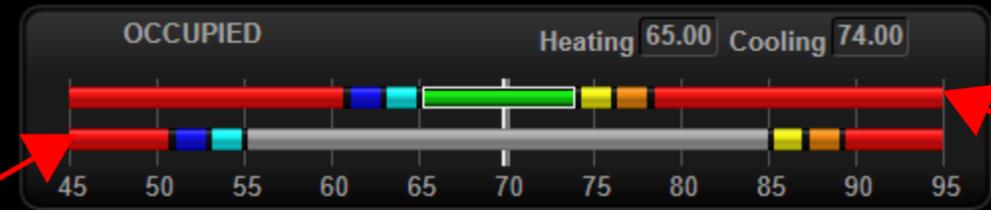
Occupied until 9:30 PM

19. RH LEVEL AND SET POINT

16. SPACE TEMP SET POINT

17. ADJUSTED SET POINTS

8. FAN STATUS



12. ADJUSTED SET POINTS

11. OCCUPIED TEMP RANGE

SECTION 23 11 23 - FUEL GAS SYSTEMS: (NATURAL)

PART 1 - GENERAL

1.01 DESCRIPTION

A. Description:

This section describes specific requirements, products, and methods of execution relating to the provision of Fuel Gas Systems for the project.

B. Scope: Provide all products, including above and below ground piping, all connection to gas burning apparatus, and all work at the gas source to provide a complete system.

C. SPECIAL NOTE: All provisions and divisions of these specifications are a part of this section of these specifications. The Contractor shall consult these divisions and provisions in detail for instructions and include all items pertaining to this work. The Contractor shall consult all other divisions of these specifications, determine the extent of impact on the work required to complete the work required by this section of the specifications or portion thereof and related work shown on the drawings.

1.02 APPLICABLE CODES

A. Provide all products and installation in strict accordance with the following:

1. Codes listed in Section 20 00 00.
2. NFPA 54 National Fuel Gas Code

1.03 CONNECTION TO UTILITY COMPANY GAS METER

A. The local gas utility company will provide underground piping to the new meter location and the new meter. Coordinate with the utility company to establish the precise meter location, and to properly integrate their work with the other work of the project. Provide the connection at the gas meter/regulator outlet using appropriate materials, compatible joints, supports, and all other products for proper interface. Verify that the utility company has inspected, tested, and approved their work before connecting to the outlet of the meter/regulator assembly. Provide necessary protection against damage for meter.

PART 2 - PRODUCTS

2.01 PIPING

- A. Schedule 40 black steel piping and fittings and conforms to standard Specifications for Welded and Seamless Steel Pipe, ASTM Designation A53, Type E or S.
- B. Schedule 40 black steel pipe with black malleable iron fittings, threaded or welded black steel pipe and fittings, Viega Mega Press or equal by Apollo.
- C. Wrap below ground piping with JM Trantex pipeline tape E-20, protective pipe coating and in accordance with local gas utility company regulations.

D. Piping (outside underground, medium and low pressure): Polyethylene type approved for gas service at pressure encountered (ASTM D2513). Butt heat fusion joints. Install per manufacturer's recommendations. All risers up to building to be black steel as specified from elbow up below grade, including elbow.

E. **Absolutely no galvanized piping or fittings allowed on gas system piping.**

2.02 MISCELLANEOUS PRODUCTS IN CONTACT WITH GAS

A. Provide line-size, lever-handle, stopcock of a type designated and approved for handling gas at each gas-consuming appliance.

B. All products bear the AGA and UL label for the use intended.

2.03 METER - BY UTILITY CO.

2.04 PRESSURE REGULATORS

A. Utility Company to provide regulators at meter that provide pressure assigned to serve building (low pressure, 2 PSI or 5 PSI).

B. Plumbing Contractor to provide all regulators required downstream of utility meter/regulator as required to feed all equipment.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Arrange all products to be readily accessible for inspection, testing, and shutting off of gas supply.

B. Install all pipe and fittings clean and free from cuttings, burrs, and defects in structure or threading, and thoroughly brushed and scale blown.

C. **All gas piping 2-1/2" and larger shall be welded (by certified welder). Use chill rings throughout.**

D. **All gas piping run inside building or concealed piping shall be welded (by certified welder). Use chill rings throughout.**

E. Do not install any building service low pressure piping in concrete, in masonry, or below grade. Any piping installed below grade is to be sleeved and vented per code.

F. Provide connection at all gas consuming appliances.

G. Provide underground stub up for connection to gas meter as required by Gas Company for meter support.

H. Reference Specification Section 20 01 00, 2.08, C., for roof roller pipe supports. All gas piping **including drip leg** is to be a minimum of 6" above finished roof surface unless noted as needing to be higher than the normal 6" minimum. Top taps off main allow for this.

I. Protect roof during installation.

- J. Support all suspended gas piping as follows: 1/2" piping at 4 foot on center; 3/4" piping at 6 foot on center; and piping 1" and larger at 8 foot on center. Reference Section 20 01 00.
- K. **Prime and paint all exposed gas piping.** Riser to match building. Verify exact color with the Architect.
- L. Provide a wrench operated plug cock valve at building entrance.
- M. Install 3" to 6" long drip legs located in accessible position at each piece of equipment for the purpose of accumulating debris, moisture and condensate. They shall be no smaller than the gas main which they drain. End of drip leg shall have a suitably sized threaded malleable iron black cap.
- N. Branches feeding more than one piece of equipment can come off side or top of main gas line.
- O. **Branches feeding a single piece of equipment must come off top of main gas line or branch.**
- P. Slope piping not less than 1/4" in 15 feet to prevent traps. All piping to drain back to meter.
- Q. **Exterior gas regulators to have unions on both sides of regulator and to have vent aimed in downward position to prevent water from collecting/freezing and cracking of regulator housing. Pipe off regulator vent to a point at least 5'-0" away from any unit. Regulators located indoors are to be properly vented to outdoors. End of all vents to have bee screen in it.**
- R. Coordinate all gas piping for kitchen equipment with kitchen plans. Provide full-size main behind equipment under hood and provide taps per kitchen equipment drawing. Provide separate isolation valve for each piece of equipment. Install emergency gas shut off valve provided by kitchen equipment supplier in main gas drop to equipment.
- S. PURGE/TESTING
 - 1. Test all gas piping before connection to the gas source. Do not enclose or conceal any untested portion of the gas system.
 - 2. Prior to pressure test all gas piping is to be cleaned/purged with compressed air or dry nitrogen at a minimum of 100 psi from end of run(s) back to a point near meter or regulator connection serving building. Shut off stops to each piece of equipment so as not to damage regulators or gas valves in equipment. Open connection at building entry and purge for at least 5 minutes or until all debris is removed. Reconnect piping.
 - 3. Pressure Test all piping in accordance with plumbing code. Test pressure to be 60 psi, soap all joints and repair all leaks.
 - 4. Obtain a certificate of final inspection from the Administrative Authority and provide a letter stating all gas piping has been tested and all leaks repaired.

END OF SECTION

SECTION 23 30 00 - AIR DISTRIBUTION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Description: This section describes specific requirements, products and methods of execution relating to the project air distribution systems.
- B. Provide all air distribution systems as shown and specified, complete in every detail and in perfect operating order.
- C. All equipment warranties to be per Specification Section 20 00 00, 1.17.
- D. SPECIAL NOTE: All provisions and divisions of these specifications are a part of this section of these specifications. The Contractor shall consult these divisions and provisions in detail for instructions and include all items pertaining to this work. The Contractor shall consult all other divisions of these specifications, determine the extent of impact on the work required to complete the work required by this section of the specifications or portion thereof and related work shown on the drawings.

1.02 Provide all air distribution work in accordance with the minimum provisions of the latest approved editions of the following codes and standards.

- A. NFPA 90 A - Air Conditioning and Ventilating Systems.
- B. NFPA 90 B - Warm Air Heating and Air Conditioning.
- C. SMACNA - Low Velocity Duct Construction Standards.
- D. TIMA - Fibrous Glass Duct Construction Standards.
- E. SMACNA - Duct Liner Application Standard.
- F. SMACNA - Ducted Electric Heat Guide.
- G. AMCA Standard 210-74 Laboratory Methods of Testing Fans for Rating Purposes.
- H. AMCA Pub. 261 Directory or Products Licensed to Bear the AMCA Certified Rating Seal.
- I. AMCA Standard 300-67 Test Code for Sound Rating.
- J. AMCA Standard 301-65 Method of Publishing Sound Ratings for Air Moving Devices.
- K. AMCA Publication 511-75 Certified Ratings Program for Louvers, Dampers and Shutters.
- L. ASHRAE Standard 52-76 Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
- M. ASHRAE Standard 70-72 Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.

- 1.03 Where any references to “sheetmetal work” or “ductwork” appears in this section of these specifications or on the drawings, it shall be construed to include outside air ducts, supply air ducts, return air ducts, exhaust ducts, relief ducts, plenums, duct taps, grille taps, diffuser connections and all other related pieces and parts of the air conveying systems.
- 1.04 Before starting shop drawings or fabrication of any duct work, the Contractor must have an approved reflected ceiling plan with which he can coordinate location of air outlets, lights, grille patterns, etc.

PART 2 - PRODUCTS

2.01 FANS

A. General Requirements for All Fans:

1. All fans constructed to AMCA Standards, AMCA listed and labeled.
2. Bearings:
 - a. At factory assembled package units 1HP and larger, provide 200,000-hour bearings (AFBMA L-50) selected at maximum fan rpm.
 - b. At packaged equipment 3/4HP and smaller, provide manufacturer’s standard bearings.
 - c. Arrange equipment for easy access to lubrication fittings. Provide extended grease lines whenever easy access is not possible.
3. Balance fans statically and dynamically at factory.
4. Factory paint fan housing, fan wheel (except aluminum), frame and support brackets with prime coat and enamel finish coat at factory, after properly preparing surfaces.
5. Arrange fans to be cleanable and so that wheel, bearings, shaft, and drive are removable. Provide plug type cleanout doors or split fan housing. Gasket joints and bolt airtight.
6. Provide vibration isolation for all fans per manufacturer’s recommendations.
7. Assemble fans at factory and test with permanent motor for proper operation, alignment, and balance.
8. **All fans are to be of similar size and operational characteristics as fans scheduled. Smaller fans run at higher speeds will not be accepted.**
9. All Exhaust and Make-up Air fans to have dampers. If backdraft dampers are not provided as an integral part of the fan provide a motorized parallel blade damper, the operator voltage / phase to match the voltage / phase of the fan that it is serving. If the voltage / phase cannot be matched provide transformers, relays, etc. required to interlock the damper with the fan.
10. Acceptable Manufactures: Greenheck - Accurex, Loren Cook, ILG, Penn, Briedert, Carnes and Twin City, CaptiveAire – Thermotek.

B. Belt Drives (All Belt Driven Fans):

1. Provide V-belt drive with sufficient belts to prevent slipping at start-up. Select drive for 1.5 service factor.
2. On each fan 10HP and smaller, provide variable pitch drive sheave with infinitely adjustable pitch diameter. Select drive sheave and fan pulley combination to provide fan rpm with drive adjusted to near mid-span.
3. On each fan 10HP and larger, provide a fixed speed drive sheave. Change fan and drive sheave in field to attain specified air delivery at completion of balancing.
4. Provide belt guard with hinged tachometer cap.

C. Roof Mounted Exhaust Fans:

1. Direct drive or have adjustable pitch v-belt AS SCHEDULED.
2. Wheels shall be backward curved, and housing shall be removable or hinged aluminum.
3. Isolate motor with vibration dampeners.
4. **Provide with motorized backdraft dampers unless gravity backdraft dampers are specifically listed on schedule. Damper actuator voltage to match fan voltage. Electrical Contractor to tie damper into fan power.**
5. **Insulated, pre-fabricated metal roof curb shall be for flat or sloped roof as required for fan to be set level on roof.**
6. **Provide with galvanized or aluminum bee screen.**
7. Maximum motor and fan rpm is not to exceed scheduled rpm by more than 50 rpm.
8. Provide with roof curb to match roof slope. Curb to be a minimum of 14" above finished roof.

D. Ceiling Exhaust Fans:

1. Centrifugal wheel with inlet perpendicular to, or remote from, inlet grille. Acoustically insulated housing.
2. 85% free open area grille.
3. Electrical junction box on fan housing with cord, plug, and receptacle inside housing.
4. Fan, motor, and wheel assembly removable through grille without disturbing housing.
5. **Motor mounted on rubber-in-sheer isolators, grounded, maximum motor and fan rpm shall not exceed scheduled rpm by more than 50 rpm.**
6. Unit supplied with grille when indicated by model number scheduled.
7. Provide and install roof cap or wall cap as shown.
8. Unit UL labeled.

9. Integral backdraft damper, shatterproof, with no metal to metal contact.

E. Utility Sets:

1. Direct drive or adjustable pitch V-belt as scheduled.
2. B. I., Airfoil or Radial Wheel as scheduled.
3. Configured as scheduled.
4. Provide with access panel and drain.
5. Provide weather cover when fan is located outdoors.
6. Provide with three foot (3') high "no loss" discharge stack with butterfly damper.
7. Provide with Pate Universal Curb Model PUC-2 with full CDX plywood deck and galvanized steel counterflashing cover with optional duct opening.
8. Utility sets to set on roof unless specifically noted otherwise.

2.02 FAN ACCESSORIES

A. Flexible Fan Connectors:

1. Provide at inlet and discharge of each fan, ERV, MAU, air handling unit, etc.
 - a. For Standard Application:
 - 1) Material suitable to withstand the pressure encountered. Constructed from coated heavy glass fabric, flameproof and ozone resistant. Joints to be sealed airtight. Minimum of 3" flex connection to be used.
 - 2) Manufacturer: Duro-dyne Corporation "EXCELON" or equal.
 - b. For Outdoor Installations and Where Duct is Exposed to Toxic Fumes:
 - 1) Material suitable to withstand the pressure encountered. Constructed from heavy glass fabric, double coated with "Neoprene", non-combustible and fire retardant. Fabric to be waterproof and airtight. Minimum of 4" flex connection to be used.
 - 2) Manufacturer: Duro-dyne Corporation Duralon or equal.
2. Insulate over flex connection at inlet and discharge of all air handling units and rooftop units with minimum two-inch (2") Type "C" insulation with minimum installed "R" value of 6.0. Seal termination of external insulation to ductwork with Childers CP-11 mastic with 3" glass fiber reinforcing mesh. Do not seal over any access panels.

2.03 DUCTWORK

- A. **Mechanical Contractor shall insure that there is an adequate return air path above the ceiling (plenum) for all systems. This includes makeup air for exhaust fan, ERV's, etc. The maximum velocity (FPM) through opening/ducts not to exceed 800 FPM. Provide internally lined duct with a ninety-degree elbow turned up on both ends through sound walls. It is the**

Mechanical Contractor's responsibility to field verify return/transfer air pathways. Prior to Air Balance Contractor starting work, verify that all plastic covering transfer openings have been removed. Mark all openings (include sizes) on shop drawings and indicate walls that are not run to deck. If the job is complicated provide a separate sheet(s) for return air paths.

B. Low Velocity Ductwork Systems:

1. Definition: Ductwork systems where duct pressures do not exceed 2" W.G. maximum static pressure and duct velocity does not exceed 2000 FPM. **Minimum duct gauge to be 26 gauge.**
2. All ductwork connected to louvers is to be sloped back to louver to insure that any water entering the duct drains back to the exterior of the building.
3. Ductwork Construction:
 - a. Ductwork, unless otherwise specified herein, shall be constructed of new, prime grade, continuous hot dip mill galvanized, lock forming quality steel sheets and shall have a galvanized coating of 1-1/4 ounces total for both sides per square foot. The gauges of metal to be used and the methods of duct construction shall conform to the requirements for the class of work involved as set forth in the latest edition of "Standard Practice in Mechanical Sheet Metal" as published by SMACNA. Each sheet shall be stenciled with the gauge and manufacturer's name. If coil steel is used, coils shall be stenciled throughout on ten-foot (10') centers with the gauge and manufacturer's name. Insulate per Specification Section 20 07 00.
 - b. All dimensions are inside clear dimensions. Sheet metal size shall be increased to allow for duct liner where applicable.
 - c. Seal all transverse joints, seams, and fitting connections with "Ductmate Proseal", Childers CP-146 or Foster 32-19, UL listed Mastic to prevent air leakage. Oil base caulking and glazing compounds are not acceptable. Duct sealant must meet VOC units per South Coast Air Quality Management District (SCAQMD) Rule #1168.
4. Rectangular Ducts:
 - a. Where special rigidity or stiffness is required, construct ducts of metal two-gauge numbers heavier.
 - b. Ducts larger than 96" require special field study for gauging and supporting and supporting methods. (Furnish shop drawings for supporting and construction requirements.)
 - c. Rectangular low-pressure ducts shall be constructed, braced, and reinforced in accordance with Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
5. Round Ducts:
 - a. Construct round ducts from steel sheets, U.S. Gauge thickness, per SMACNA standards.

- b. All exposed round ducts shall be double wall spiral duct per SMACNA standards with segmented fittings regardless of size.
- c. Supply, return and exhaust duct runouts to/from air device shall be gauges as follows:
 - 1) up to 12" diameter 30 gauge,
 - 2) 14" to 18" diameter 28 gauge, and
 - 3) 20" to 22" diameter 26 gauge.

Provide minimum 26 gauge, 1" wide strap on heel and throat of adjustable fitting to provide additional rigidity.

6. Transitions:

- a. Provide tapered transitions at changes in duct size and at connections to fans and other equipment.
- b. Offset not more than 20°, on diverging flow and 30° on contracting flow, unless called for otherwise on drawing.

7. Elbows and Turning Vanes:

- a. Use long radius, 45° and 90° fittings for all elbows and at tees, unless otherwise shown or space restrictions dictate use of square elbows.
 - 1) Construct fittings with centerline radius equal to 1-1/2 times the duct width at the turn.
 - 2) Where square vaned elbows are used, provide access doors as detailed below.
- b. Turning Vanes: In all 90° turns in supply air ducts where 1-1/2 radius elbows cannot be used, install double radius turning vanes in square elbows.
 - 1) Ducts 19" and Smaller: Use small double vanes with an inner radius of two inches (2") and an outer radius of one inch (1") mounted on 3/4" center.
 - 2) Duct 19" and Larger: Use large double vanes with an inner radius of four inches (4") and an outer radius of two inches (2"), mounted on three (3) 1/4" centers. Provide sound reduction type turning vanes: "Airsan" Acoustiturn, by Air Filter Corporation, "Sone-Turn" by Sound Control Products Company, per SMACNA Plat 22, or equal.
 - 3) **Provide 12" x 12" insulated access door into duct on both sides of each vaned fitting to facilitate duct cleaning.**

8. Flexible Duct:

- a. Do not use flexible duct except where specifically called for on the plans.

- b. At diffuser connections:
- 1) Provide duct listed as UL-181 Class I air duct and constructed in compliance with NFPA 90A.
 - 2) **Minimum length 2.5 feet, maximum length 5 feet for supply ducts. Minimum length 2.5 feet, maximum length 5 feet for return air ducts. Install with not more than one (1) 90 full radius degree bend. Minimum and maximum lengths are to be closely followed since the flex duct acts as a main source of sound attenuation in the air system. Install with some slack in runout.**
 - 3) Make joints with Nashua brand UL181A-P Duct Tape (Venture #1599B or Shurtape #PC857) and two (2) 1/2" wide positive locking straps, one on inner core and one on outer jacket. Use Panduit straps.
 - 4) Minimum sound net insertion loss for duct as follows:

BAND, HZ	125	250	500	1000	2000
Loss dB/ft.	2.1	3.0	2.7	3.0	2.7
 - 5) Submit sound and construction data for proposed alternates.
 - 6) Tough vapor barrier reinforced metalized polyester jacket, tear and puncture resistant.
 - 7) Airtight inner core with no fiberglass erosion into airstream.
 - 8) **R-Value: 6.0 @ 75°F. mean temperature if within building insulation envelope, or R-value of 8.0 if outside building insulation envelope.**
- c. **Do not use regular flex duct on exhaust systems. Final connections to exhaust air devices can be made with metal flex not to exceed 5'-0" in length.**
- d. Manufacturers: **Atco 36 Series**, Certainteed, Thermoflex, Wiremold, Genflex, approved equal.

C. Medium Velocity Ductwork Systems:

1. Definition: Ductwork systems where duct pressures exceed two-inch (2") W.G. static pressure and/or duct velocities exceed 2000 fpm (all primary air ductwork to fan terminal boxes).
2. Ductwork Construction:
 - a. Construct all ductwork from fan discharge to terminal units using round duct fabricated from galvanized steel sheets in accordance with SMACNA High Velocity Standards, as indicated below:
 - 1) All ductwork and fittings in the Mechanical Rooms.
 - b. Seal all transverse and longitudinal joints per SMACNA.

3. Round Ducts:
 - a. Construct round ducts from steel sheets of the following U.S. Gauge thickness, using the seam method shown.
 - b. Ducts up to 13" diameter; 24 gauge. Long or spiral seam.
 - c. Ducts 14" through 22" diameter; 22 gauge. Long or spiral seam.
 - d. Ducts 23" through 36"; 22 gauge. Spiral lock seam duct.
 - e. Ducts 37" through 50"; 20 gauge. Spiral lock seam duct.
 - f. Ducts 51" through 60"; 18 gauge. Longitudinal seam duct.
 4. Seams and Joints:
 - a. Longitudinal Seams: Butt welded or lock-type joint.
 - b. Spiral Seams: Lock-type joint.
 5. Fittings, Couplings and Other Joints:
 - a. Construct using minimum 22 gauge sheets. Spot weld along seams according to accepted trade practices.
 - b. Provide runout fittings, such as Y's, 45°, 90°, conical 90° with baffle as detailed on the runout fitting schedule. Design "tap-on" installation. Provide runout fittings requiring an orifice "built-in."
 - c. Make all connections using sheetmetal screws. Apply 3M Duct Sealer 800 (900 on 20" diameter and larger) to all joints to eliminate leakage and cover with UL181AP labeled duct tape, Nashau or approved equal. Use heat shrink factory fabricated joint sealer, "Thermofit" or approved equal as an alternate.
 6. Flexible Duct:
 - a. Do not use flexible duct unless specifically called for on the plans.
 - b. Connection between main duct and terminal box.
 - 1) Provide flexible duct listed as UL-181 Class I air duct and constructed in compliance with NFPA 90A.
 - 2) Do not install more than four feet (4') of flexible duct between main and terminal box, using no more than one (1) 45° bend.
 - 3) On insulated runouts, use insulated flexible duct, Thermoflex Type M-KH or approved equal. Fasten with 1/2" wide positive locking metal bands.
 - 4) All ducts rate 10" W.G. minimum static pressure.
 - 5) Manufacturers: Thermoflex, Wiremold, Genflex or approved equal.
- D. Entire interior of ducts shall be thoroughly cleaned of all oil residue and dust prior to installing.

2.04 DUCT ACCESSORIES

A. Air Volume Controls:

1. Provide air volume dampers, or other control devices, at each low-pressure duct main and branch for a balancer to adjust the system to produce the air quantities shown.
 - a. Provide opposed blade damper for balancing in each zone duct for HETD. Locate downstream of first elbow in accessible location and indicate location on record drawings.
2. Volume Dampers:
 - a. Flat sheet, single leaf damper with a continuous rod; damper leaf two (2) gauges (minimum 16 gauge) heavier than the duct where installed. Provide locking quadrants with indicators located accessible without demolition.
 - 1) Use for supply, return and exhaust ductwork 14" round or 14" x 14".
 - b. The locking-type quadrant operators for dampers, when installed on ducts to be thermally insulated, shall be provided **with stand-off mounting brackets, bases, or adapters to provide clearance, between the duct surface and the operator, not less than the thickness of the insulation.** Stand-off mounting items shall be integral with the operator or a standard accessory of the damper manufacturer. All volume dampers indicated shall be provided with stand-off mounting brackets as required.
 - c. **All operators accessible and lockable. Do not insulate over top of volume damper operator handle.**
 - d. Locate dampers a minimum of 4 feet from diffusers.
 - e. Damper operators must be easily accessible to T&B contractor, install no more than 4 feet above ceiling.
3. Extractors:
 - a. Combination air straightening vanes and volume control with locking quadrant on outside or accessible through face of register.
 - b. Manufacturer: Titus AG-45 or approved equal.
 - c. Provide extractors at supply grilles attached directly to any main or branch duct serving more than one (1) grille.
4. Splitter Dampers:
 - a. Construct damper using sheetmetal blade hinge mounted inside duct.
 - b. Dampers or splitters shall be constructed from the same gauge metal as the ducts which they serve with a minimum of 22 gauge. Splitter length shall be 1-1/2 times the duct width up to 24" in size and above 24" in size shall be 1-1/4 times the duct width.
 - c. Attach Duro-dyne SRP-40 series splitter damper bracket to blade.

- d. Connect 1/4" steel rod to damper bracket and extend through Duro-dyne SRP-14 ball joint damper casting mounting on outside of duct. Use 3/8" steel rod for splitter in ducts above 24" in size.
 - e. Install assembly for full swing of damper blade. Lock damper in proper position.
5. Opposed Blade Dampers:
- a. Provide opposed blade balancing dampers with multiple blades equal to Greenheck VCD-15, 20-gauge frame and 16-gauge blade construction with synthetic axle bearings and 1/2" diameter operator, complete with 1" stand-off and manual locking quadrant as follows:
 - 1) Use for outside air ductwork. Minimum damper size is actual duct size or 10" x 10", whichever is larger. Provide transitions as required.
 - 2) Use for supply, return and exhaust ductwork - 14" round or 14" x 14" and larger.
 - b. Damper material is to match ductwork material. (i.e., galvanized aluminum, stainless steel, etc.)
- B. Gravity Backdraft Dampers:
- 1. Provide backdraft dampers counterbalanced to desired static pressure setting. Wide open static pressure drop not to exceed 0.15" W.G.
 - 2. Damper blades aluminum with felt applied to tops of blades. Where dampers are exposed to outside temperature, provide neoprene edged blades.
 - 3. Damper frames extruded aluminum; nylon bearings.
 - 4. Assembly designed for operation at 20°F.
- C. Access Panels and Doors:
- 1. Low Velocity System Access Panels:
 - a. Sheetmetal doors reinforced, cross-bracketed or otherwise stiffened to prevent rattle or vibration.
 - b. Seal doors airtight with felt edged gaskets.
 - c. Secure with hinges and sash locks.
 - d. Panels and doors for insulated duct systems are to be insulated.

2.05 GRILLES, REGISTERS AND DIFFUSERS

- A. Provide grilles, registers, and diffusers of the types and sizes called for on plans and in schedule on drawings.
- B. Finish with factory applied finish for extruded aluminum items, and with a prime coat for steel items. (Provide an additional factory baked enamel finish to match ceiling grid.) (Submit color sample for approval.)

- C. Equip diffusers with panels of the proper size to match the suspended ceiling layout or with the proper frame for surface mounting. Fully correlate diffuser and grille style, dimension and fit with ceiling.
- D. Manufacturers: Price, MetalAire, Titus, Tuttle & Bailey, Krueger, Anemostat, Carnes
- E. All air devices located in damp areas are to be constructed from all aluminum components.
- F. Provide minimum 12" deep externally insulated boot for sidewall type supply air devices.
- G. Provide square to round transitions as required.
- H. Provide minimum 12" deep (top duct tap) or 24" deep (side duct tap) externally insulated boot for return air and transfer air devices.
- I. Provide minimum 12" deep boot for all exhaust devices.

2.06 LOUVERS AND HOODS

- A. Provide air exhausts through building skin, as shown.
- B. Louvers:
 - 1. Size as shown; air pressure drop not to exceed 0.15" W.G. when handling 1150 FPM per square foot of free area.
 - 2. Water penetration not to exceed .02 oz. per sq. ft. when handling 1150 FPM per square foot of free area.
 - 3. 4" deep drainable louver constructed of .125" thick 6063-T52 extruded aluminum alloy with channel frame.
 - 4. **Provide with 1/8" X 1/8" galvanized hardware cloth bee screen.**
 - 5. Finish to be factory primed for field painting or applied .7 mil thick anodized dark bronze as directed by Architect.
 - 6. Manufacturers: Greenheck ESD-403, Arrow, Carnes, Greenheck, Ruskin, Empco, Pottorff, or approved equal.
 - 7. Any plenum or ductwork attached to louver is to slope to drain back through louver to exterior of building.
- C. Hoods:
 - 1. Construction of heavy-duty aluminum sheets with rolled interlocking seams with galvanized hood support members, similar to Greenheck Fabrahood or equal.
 - 2. Provide with bee screen on outside air intake hoods and 1/4" x 1/4" galvanized bird screen on relief hoods.
 - 3. **Curbs are to be a minimum of fourteen inches (14") high above finished roof surface and match slope of roof.**
 - 4. Manufacturers: Greenheck, Acme, Penn, Cook, Briedert and Carnes.

5. Provide 120-volt motorized damper.

2.07 AIR FILTERS

A. General:

1. All air filters to be listed as Class 2 by Underwriters Laboratory, Inc., Building Materials Directory.
2. All arrestance, efficiency (dust spot efficiency on atmospheric air) and dust holding capacities specified are to be in accordance with ASHRAE Standard 52-76.
3. Performance characteristics are to be verified by certified data published in manufacturer's literature or by copies of current test data from an independent authorized test laboratory. Test data, where required, shall be an integral component of the manufacturer's submittal data.
4. Provide and install one (1) clean set of filters in all air moving units that require filtration at completion of project.

B. Grease Rated Filters (for all return air filter grilles located in kitchens):

1. Media: Multiple layers of aluminum sheets that are corrugated, slit then expanded into a series of baffles. Media protected on both sides by expanded aluminum grid.
2. Initial Resistance: .06" W.G. at 350 fpm.
3. Frame: Single piece of heavy gauge two-inch (2") aluminum u-channel with "compression" flanges that grip the media and lock it to the frame.
4. Filter shall be washable.
5. Manufacturers: American Air Filter, mesh type grease filter or approved equal.

C. Disposable Panel Filters (for return air filter grilles and/or unit filter racks):

1. Media: Non-woven, lofted cotton bonded to 96% free area welded wire support grid. Not less than 2.45 square feet media area per square foot of filter face area. Arranged in radially pleated configuration and bonded continuously to inside perimeter of high wet-strength beverage board cell sides.
2. Cell Design: Two inches (2") deep with beverage board diagonal supports at entering air and leaving air faces of each cell.
3. Air Cleaning Performance: Minimum 25-30% efficiency 90-92% arrestance, MERV-8.
4. Initial Resistance: 0.2" W.G. at 500 fpm face velocity.
5. Dust Holding Capacity: Not less than 200 grams when operated at 500 fpm face velocity to a final resistance of .9 W.G.
6. Manufacturers: Cam-Farr Company Aeropleat II; AAF or approved equal.

D. Temporary Filters:

1. Reference 20 00 00, 3.07 for temporary filter requirements.

2.08 UNIT HEATERS (ELECTRIC)

- A. Provide UL listed electric unit heaters with voltage, phase, number of steps, heating, and air delivery capacities, as scheduled. Suitable for vertical and horizontal mounting.
- B. Casings fabricated of die-formed heavy gauge steel and finished in high gloss baked enamel.
- C. Steel finned tubular element. Provide automatic reset thermal cutout for each element.
- D. Individually adjustable discharge louvers.
- E. Thermostat to match number of heater control steps. Wall mount or built-in as scheduled.
- F. Provide angle support between unit heater threaded rod supports and nearest wall to prevent unit sidesway.
- G. Manufacturers: Markel, Brasch, Modine, Trane, Berko or approved equal.

2.09 FIRE DAMPERS

- A. Provide and install all fire dampers in all ductwork which passes a fire wall or fire rated ceiling as required by local building and fire safety codes.
- B. All dampers folding blade type with no part of blade in the air stream.
- C. Provide "out of wall or floor" type fire dampers where space restrictions or conditions dictate and at all wall mounted grilles in rated walls..
- D. All fire dampers UL approved and of type required by NFPA 90A.
- E. Install all fire dampers per manufacturer's instructions. Installation detail must be submitted with damper submittal. **Post detail at job site in area of building permit.**
- F. Provide UL rated sleeves and manufacturer supplied wall angles with damper.
- G. Provide four additional fire dampers to be sized and installed as directed by Architect.
- H. Manufacturers: Ruskin, Air Balance, Arrow, Greenheck, Nailor or approved equal.

2.10 FIRE/SMOKE DAMPERS

- A. Provide and install all fire/smoke dampers in all ductwork which passes through a smoke wall and/or any rated egress pathways, as required by local building and fire safety codes, and as indicated on the drawings.
- B. All dampers shall have qualified electric operators.
- C. Provide "out of wall or floor" type fire/smoke dampers where space restrictions or conditions dictate.
- D. All dampers UL approved and of type required by NFPA 90A.

- E. Install all dampers per manufacturer's instructions. Installation detail must be submitted with damper submittal. **Post detail at job site in area of building permit.**
- F. All dampers shall have a UL555S leakage classification of II.
- G. Provide UL rated sleeves and manufacturer supplied wall angles with damper.
- H. Provide four additional fire/smoke dampers to be sized and installed as directed by Architect.
- I. Manufacturers: Ruskin, Air Balance, Arrow, Nailor, Greenheck or approved equal.

2.11 CORRIDOR CEILING FIRE SMOKE DAMPER

- A. Provide and install appropriate corridor ceiling fire smoke dampers in all air devices located in ceiling portion of fire rated floor/ceiling and/or roof ceiling assemblies.
- B. Damper must be classified as a **Corridor Ceiling Fire Smoke Damper**.
- C. All dampers must be UL approved and of the type required by NFPA 90A.
- D. Provide two (2) additional corridor ceiling fire smoke dampers to be located and sized as directed by the Architect.
- E. Install per manufacturer's recommendation, submit detail. **Post detail at job site in area of building permit.**
- F. Manufacturers: Ruskin, Air Balance, Arrow, Nailor, Greenheck or approved equal.

2.12 CEILING FIRE DAMPER

- A. Provide and install appropriate ceiling fire dampers in all air devices located in ceiling portion of fire rated floor/ceiling and/or roof ceiling assemblies.
- B. Damper must be classified as a **Ceiling Fire Damper**.
- C. All dampers must be UL approved and of the type required by NFPA 90A.
- D. Provide ten (10) additional fire dampers to be located and sized as directed by the Architect.
- E. Install per manufacturer's recommendation, submit detail. **Post detail at job site in area of building permit.**
- F. Manufacturers: Ruskin, Air Balance, Arrow, Nailor, Greenheck or approved equal.

PART 3 - EXECUTION

3.01 LOW VELOCITY DUCTWORK

- A. Provide ductwork in accordance with SMACNA low velocity standards.
- B. Provide backdraft dampers for all exhaust fans if motor operated dampers are not called for. Provide one-inch (1") mesh bird screen at all exhaust discharges.

- C. Seal all transverse joints, seams, and fitting connections with KINGCO 11-376 "Super Seal" or "Ductmate Proseal", U.L. listed.
- D. Where ducts exposed to view, pass through walls, floors, or ceilings, furnish, and install sheetmetal collars to cover the voids around the duct.
- E. This work shall be guaranteed for a period of one (1) year from and after the date of acceptance of the job against noise, chatter, whistling or vibration and free from pulsation under all conditions of operation. After the system is in operation, should these defects occur, they shall either be removed and replaced or reinforced as directed by the Owner.
- F. Duct shall be erected in the general locations shown on the drawings but must conform to all structural and final conditions of the building. Before fabricating any ductwork, the Contractor shall check the physical conditions at the job site, and shall make all necessary changes in cross sections, transitions, offsets, etc., whether they are specifically indicated or not at no additional charge to the Owner.
- G. Reinforce all ducts to prevent buckling, breathing, vibration or unnecessary noise, such reinforcing to be as recommended in the SMACNA manual plus any additional reinforcing as may be required to meet job conditions.
- H. Provide manually operated volume control dampers (with stand-off mounting brackets for externally insulated ductwork) in all branches, splits and taps for proper balancing of air distribution, whether shown on drawings or not, dampers to be either single blade or multi blade as shown in the SMACNA manual as required. They shall incorporate an indication device with lock to hold damper in position for proper setting.
- I. Damper operators in all unfinished areas shall be Young Series 400 of the exact style, type and size required. All other operators shall be Young #315 and/or #896 opposite end from the operator. Where dampers are installed in ducts located above accessible type ceilings, damper operators shall not be extended through the finished ceiling.
- J. All square elbows shall have turning vanes per the SMACNA manual requirements.
- K. Where ducts connect to fans, including roof exhausters, flexible connections shall be made using "Ventglas" fabric that is fire-resistant, waterproof, mildew-resistant and practically airtight, and shall weigh approximately thirty ounces per square yard. There shall be a minimum of two and one-half inches (2-1/2") distance between the edges of the ducts. There shall be a minimum of one inch (1") of slack for each full inch of static pressure on the fan system.
- L. Furnish and install screens on all ducts, fans, etc. furnished by the Contractor which lead to, or are outdoors. Screens shall be 16 gauge, three-eighths inch (3/8") mesh in removable galvanized steel frames.
- M. All holes in ducts for damper rods and other necessary devices shall be either drilled or machine punches (not pin punches) and shall not be larger than necessary. All duct openings shall be provided with sheetmetal caps if the openings are to be left unconnected for any length of time. All panels of ducts twelve inches (12") and larger shall be cross broken.
- N. Furnish and install a minimum 16 x 16 x 2 internally insulated (foil facing to airstream) filter rack with a hinged type access door with cam or spring lock and filter in all unfiltered raw outside air ducts that connect directly to return air plenums.
- O. **All ductwork that is connected to any exterior louver or wall cap, etc. shall be sloped to drain outside.**

3.02 DUCTWORK SUPPORTS

A. Support all ductwork to prevent sag, undue play, and swing. All horizontal ducts shall have a support within 2' of each elbow and within 4' of each branch intersection. Provide a hanger within twelve inches (12") from unit supply and return. Return air plenums on back of air handling units must have a minimum of four (4) support straps.

B. Low Pressure Ductwork:

1. Duct 40" and Less: Provide with 1" x 18-gauge straps fastened to ductwork, and to building construction. Space not more than eight feet (8') on center. Hanger straps shall lap under duct a minimum of one inch (1") and have a minimum of one (1) fastening screw on the bottom and two (2) on the side.
2. Ducts Over 40": Provide mild steel threaded rods fastened to angle iron supports under duct with nuts and to building construction with appropriate inserts, flanges or clamps. Space not more than four feet (4') on center with rods and angle supports as follows:

Angle Length	Angle	Rod Dia.
4'-0"	1-1/2" x 1-1/2" x 1/8"	1/4"
6'-0"	2" x 2" x 1/8"	1/4"
8'-0"	2" x 2" x 1/8"	3/8"
10'-0"	3" x 3" x 1/8"	3/8"

- C. Vertical ducts supported where they pass through the floor lines with 1-1/2" x 1-1/2" x 1/4" angles.
- D. Recommend methods of fastening bracing to ductwork, including riveting, bolting and tack welding.
- E. All flex duct runouts must be properly supported. Use minimum twelve (12) gauge wire with 8" long saddle that fits up to mid-point of duct for support of flex duct. **Web Type fabric duct support is strictly prohibited.** Maximum permissible sag is 1/2" per foot of spacing between supports.
- F. Provide 1" x 20-gauge straps, minimum 8' - 0" o.c. for all round sheetmetal runouts that are 18" in diameter or less (except Spiral Ducts).
- G. Spiral ductwork is to be supported with 2" x 18-gauge strap bands around duct with a 3/8" bolt and nut connection at top. Connect to structure with minimum 3/8" all thread rods, minimum 8'-0" o.c.

3.03 ACCESS

- A. Furnish all fans with consideration of location of motor and drive.
- B. Furnish and install in the ductwork, hinged access doors to provide access to all manual and automatic dampers, fusible links, cleaning operations, etc. Where the ducts are insulated, the access doors shall be double skin doors with one inch (1") of insulation in the door. In rectangular ducts larger than twenty inches (20") in their smallest dimension, install access doors every twenty feet (20'). Where the size of the duct permits, the doors shall be eighteen inches (18") by sixteen inches (16"). Factory fabricated doors as manufactured by Milcor meeting these specifications will be acceptable. Access doors shall be submitted for approval.
- C. Each fire damper door shall have a label with letters not less than 1/2" in height reading "**Fire Damper**", "**Corridor Ceiling Fire Smoke Damper**" or "**Fire/Smoke Damper**" (as applicable).
- D. Cycle damper after installation to insure free movement. Seal opening around fire damper with non-combustible material to maintain integrity of one (1) hour fire wall.

- E. Provide access door in supply air and return air drops from rooftop units. Access door to be in accessible location directly above first elbow. Access doors to be 18" X 18" minimum where duct size allows. Access doors shall be shown on ductwork shop drawings.
 - F. Provide access doors for maintenance inspection and cleaning in each zone duct for HETD. Locate downstream of first elbow in accessible location and indicate location on record drawings.
- 3.04 Fully coordinate and work directly with the Balancing and Testing Agency to provide all systems in perfect operating order. Make corrections and adjustments as required by the Balancing and Testing Agency in a timely manner.
- 3.05 For Each Dryer: Provide 4" diameter or 5" x 3" rectangular flue pipe up through the wall and ceiling cavity and terminate into Briedert Cap. Provide transitions as required. Provide 4" diameter tie in point for residential type dryer or stacked washer dryer as required.
- 3.06 **CAP OPEN ENDS OF ALL DUCTS (INCLUDING SPIN-INS) AND EQUIPMENT WITH MINIMUM FOUR (4) MIL. PLASTIC TO PREVENT CONSTRUCTION DEBRIS AND DUST FROM ENTERING OPENINGS AT ALL TIMES DURING CONSTRUCTION.**

END OF SECTION

SECTION 23 70 00 - MECHANICAL EQUIPMENT D - X SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section describes specific requirements, products, and methods and execution relating to the D-X mechanical equipment for the project.
- B. Provide complete operating installation for all systems shown and specified. Air handling unit, indoor coil and condensing unit shall be from single manufacturer.
- C. **Reference 20 00 00 for information that must be supplied with submittals for use by Mechanical Contractor and/or Controls Contractor.**
- D. **Reference 20 00 00 for warranty requirements.**
- E. SPECIAL NOTE: All provisions and divisions of these specifications are a part of this section of these specifications. The Contractor shall consult these divisions and provisions in detail for instructions and include all items pertaining to this work. The Contractor shall consult all other divisions of these specifications, determine the extent of impact on the work required to complete the work required by this section of the specifications or portion thereof and related work shown on the drawings.
- F. **Equipment manufacturer/vendor must submit written sequence of operation for all modes of operation for each piece of mechanical equipment with the equipment submittal. Give narrative explaining exactly what control signals are required to activate each mode of a particular unit's operation. Include information about which signals override others internally (when applicable). Submit this information with equipment submittal and provide a copy to the Controls Contractor so it can be integrated into the control scheme and control submittals. Indicate whether 24 VAC, 4-20 MA, 0-10VDC or line voltage is required for controls.**
- G. **Controls: (ALL UNITS) Provide HVAC equipment with a controls interface that is suitable for connection to a standard conventional thermostat and/or non-proprietary DDC control systems with thermostat interface unless it is SPECIFICALLY scheduled otherwise.**
 - 1. Thermostat: (Only applies when no other control systems specified)
 - a. Pelican Wireless Thermostat (TC series) **TC4** (Temp,RH,CO2) **and Pearl module** to provide discharge air and additional functionality(ALL UNITS). Wi-Fi enabled with free mobile apps and easy to use Web Portal. Thermostat to have touch screen, 365 day scheduling and 7 day programmability. Thermostat to have up to 4 heat stages and up to 2 cool stages. Provide with 2 hour override and dehumidification capability.
 - b. Ethernet Gateway (GW400) locate in IDF room.
 - c. Set all points to trend historical data for max time allowed.
 - d. Chip Parish – 832-823-9523 – chip@pelicanwireless.com
 - 2. When building has DDC system, units are to be controlled by DDC sensors with appropriate controllers by Controls Contractor.

H. Commissioning Requirements:

1. Equipment manufacture representative required to show compliance with code required and Owner required commissioning scope.
2. **Equipment manufacture is required to (related to manufacturer's equipment) provide all information and participate in all meetings required by Equipment Start-Up, Test and Balance, Controls, and Commissioning Specification to ensure HVAC system is function properly, and passes Functional Testing during Commissioning of HVAC System.**
3. **Money will be held until ALL CX activities are addressed and completed.**

PART 2 - PRODUCT

2.01 AIR HANDLING UNIT

- A. **Air handler shall be a factory assembled unit, UL listed with fuses or circuit breakers, blower, heaters, steel casing and completely wired. Air handler and coil section may be bolted together in field but must be a mated pair from a single manufacturer.**
- B. Cabinet:
1. At least 22 gauge cold rolled steel with baked enamel finish (galvanized finish not acceptable). Interior of cabinet around electric heating elements shall be lined with 1/2 inch thick 1-1/2 lb. density fiberglass insulation. All access panels to be easily removed and reinstalled for service.
 2. Insulated stainless steel internal drain pan (factory installed).
- C. Blower:
1. Centrifugal type, dynamically and statically balanced.
 2. High efficiency direct driven multi-speed blower, factory installed with at least three blower speeds. Provide multistage air volume/single zone VAV airflow for all multistage units.
- D. Heaters:
1. Nickel-Chromium Element(s). Element(s) to be sequenced on.
 2. Three phase units to have true three phase heating elements or groups of 3-single phase heaters wired to provide a true and inherently balanced three phase electrical load.
 3. Each set of heaters shall be equipped with limit control with fixed temperature "OFF" setting and automatic reset with supplemental thermal cut-off safety fuses.
 4. Provide air handler with fan time-delay relay, manually reset transformer and complete internal control system.
 5. **Provide 208 volt units with fuses or circuit breakers required for overload and short circuit protection.**
 6. Stage elements on 1PH units over 8KW.

7. Stage complete banks of elements on 3PH units having 16KW or more. Example, 16KW 3PH heater to have two 8KW 3PH banks of heaters.

E. Furnace:

1. Furnace shall be a factory assembled unit, UL & AGA listed with blower, steel casing, control transformer and completely wired.
2. Die-formed, heavy gauge, cold-rolled steel or aluminized tubular heat exchanger with minimum ten (10) year warranty.
3. Powered forced draft combustion.
4. Spark ignition pilot.
5. Provide with temperature activated fan and limit control.
6. Provide furnace with fan time delay, manually reset transformer and complete internal control system.
7. Cabinet to be at least 22 gauge cold rolled steel with baked enamel finish. Galvanized cabinet not acceptable.
8. Blower compartment to be lined with 1/2" thick, 1-1/2" lb. density fiberglass insulation.
9. High efficiency direct driven multi-speed blower, factory installed with at least three blower speeds. Provide multistage air volume/single zone VAV airflow for all multistage units.

F. Cooling Coil:

1. Factory leak-tested, dehydrated, sealed and shipped with holding charge.
2. Coil installed in baked on enamel finish insulated casing (unless it is to be installed inside air handlers).
3. Staggered row copper tube, aluminum fins. Aluminum evaporator coils strictly prohibited.
4. Coils to be ARI certified and matched to system.
5. Provide with thermal expansion valve mounted inside AHU cabinet. (Capillary tubes or piston type metering devices are not acceptable).
6. Insulated stainless steel internal drain pan (factory installed).

G. Filter:

1. Provide two inch (2") thick pleated filter equal to Cam Farr Aeropleat II.
2. Provide two inch (2") thick mesh grease filter equal to those manufactured by American Air filter for all return air grilles located in Kitchen areas.
3. Install filters at return air filter grilles if system is equipped with them and at AHU when standard non-filtered return grilles are used.

4. Provide suitable insulated filter rack with hinged access door at base (inlet) of unit to house 2" thick filters when filters are to be installed at AHU.

H. Electrical:

1. **All units to be provided with terminal block type connection point for single electrical connection point. Loose wires and wire nut connection points are not acceptable.**

I. Approved Manufacturers: Base Bid: Lennox. Alternate Bid: Trane

2.02 CONDENSING UNITS/HEAT PUMPS

A. Condenser coil shall have copper tubes with aluminum plate fins mechanically bonded.

B. Fans shall be direct driven propeller upflow type.

1. Fan motor thermostatically controlled, permanently lubricated, and designed with permanent protection.
2. Motors shall be resiliently mounted.
3. Each fan shall have a safety guard.

C. Unit shall operate properly in the cooling mode down to a minimum of 55° F, unless otherwise noted on schedule.

D. Each condensing unit shall have one (1) compressor. Compressor shall be of hermetic design with the following features.

1. Crankcase heater (except on scroll compressor).
2. Resilient rubber mounts.
3. Compressor motor overload protection.

E. Controls:

1. Factory wired and located in separate enclosure.
2. High and low pressure cutout and condenser fan motor overload devices.
3. Off-cycle timer to prevent short-cycling of compressor and shall prevent compressor from restarting for 5 minutes if power is interrupted.
4. **Provide factory hard start kits for all single phase units.**
5. All interior units provided with low ambient control for operation down to 30°F.

F. Casing:

1. Fully weatherproof for outdoor installation. Baked-on enamel finish on all exterior surfaces.
2. Openings shall be provided for power and refrigerant connections.

3. Panels shall be removable for servicing.
 4. Coil guards.
- G. Provide externally mounted brass service valves with charging connections.
- H. When AHU's/CU's or HP's come to the job site in sections, or when parts are sent for field installation, **all** pieces must be clearly marked as to which unit mark system they go with.
- I. Condensing units/heat pump outdoor units to be products of same manufacturer as air handler and coil.
- J. Manufacturers:
1. Base Bid: Lennox, Daikin, Trane (as specified on plans).
 2. Alternate Bid: Other manufacturers are acceptable as listed alternate bid only

2.03 REFRIGERANT SYSTEM

- A. Furnish and install refrigeration system complete as a system with all refrigerant, oil, valves, dehydrators, gauges, flex connections and controls as required for proper operation.
- B. Refrigerant Piping:
1. Meet requirements of ASTM B 280-83, "Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service," Type "L" or Type "K" only.
 2. All refrigerant piping installed outdoors or in accessible spaces shall be hard drawn copper.
 3. **Refrigerant piping in inaccessible spaces, such as wall cavities, or in underground sleeves is to be soft drawn copper with no fittings in the inaccessible areas. All bends required are to be made with refrigeration tubing bender.**
 4. **Refrigerant piping outdoors to be insulated and be covered with an aluminum jacket with seams located on bottom side of horizontal piping. Jacketing to be neatly installed.**
- C. Refrigerant Fittings:
1. Wrought copper with long radius elbows.
 2. Approved Manufacturers:
 - a. Mueller Streamline
 - b. Engineer approved equal.
- D. Suction Line Traps:
1. Manufactured with one (1) 90° short radius elbow and two (2) 45° fittings.

- E. Connection Material:
1. For Brazing--
 - a. Sil-Fos (minimum 10% silver content)
- F. Expansion Valves:
1. **Provide thermal expansion valve for each system.**
 2. Size valves to provide full rated capacity of cooling coil served.
- G. Filter-Drier:
1. On lines 3/4" outside diameter and larger, filter-drier shall be replaceable core type with non-ferrous casing and Schraeder type valve.
 2. On lines smaller than 3/4" outside diameter, filter-drier shall be a sealed type using sweat copper fittings.
 3. Size shall be full line size and rated for tonnage and refrigerant used.
 4. **Liquid line filter driers are required for each unit. However, if liquid line filter drier comes as an integral part of the condensing unit or heat pump outdoor unit, additional filter driers shall not be installed.**
 5. External liquid line filter driers for heat pumps must be bi-flow type.
 6. Manufacturers: Mueller, Alco or Sporlan.
- H. Sight Glass:
1. Combination moisture and liquid indicator with protection cap.
 2. Sight glass shall be full size of liquid line.
 3. Sight glass connections shall be solid copper or brass.
 4. **Required for each system utilizing expansion valve.**
 5. Manufacturers: Mueller, Alco or Sporlan.
- I. Manual Refrigerant Shut-Off Valve:
1. Ball valves designed for refrigeration service and full line size.
 2. Valve shall have cap seals.
 3. Valves with hand wheels are not acceptable.
 4. Provide service valve on each liquid and suction line at compressor.
 5. **If reusable service valves come as integral part of condensing unit, additional service valves shall not be installed.**

6. Manufacturers: Mueller, Superior

2.04 ROOFTOP UNITS

- A. General: Single package unit completely factory assembled and tested, including refrigeration, heating, fans, dampers, piping, wiring and control.
- B. Cabinet: Heavy gauge galvanized with baked on acrylic enamel, all exterior parts are fully insulated with heavy density fiberglass (1" 3/4 lb.) permanently fastened to panel. Install heavy gauge painted hail guards equal to RSI Model 50-805-Series Hail Guards. **Entire base pan of unit to be insulated.**
- C. Filters: Provide two inch (2") thick pleated filters equal to Cam Farr Aeropleat II, minimum MERV 7.
- D. Low Ambient Control: Unit shall operate properly in the cooling mode down to a minimum of 25°F, unless otherwise noted on schedule.
- E. Refrigeration System: Complete with protection from short cycling of compressor with automatic timing circuit, evaporator and condenser to be copper tube with aluminum fins, refrigerant metering devices, filter driers, crankcase heaters (except on scroll compressors), thermal and overcurrent protection for compressor(s), high and low pressure cutouts. Provide minimum two (2) stages of fully independent cooling on RTU's 7-1/2 tons and over. Where multiple compressors are used, provide one compressor per refrigerant circuit. Insulated stainless steel internal drain pan (factory installed).
- F. Heating System: (As scheduled): Indirect type fired with automatic spark ignition and power forced draft combustion. Controls to include pilot valve, combination main gas and pressure regulator, high limit thermostats, flame sensor and automatic relight system. Provide minimum two (2) stages of heat on RTUs of over five (5) tons cooling capacity.
- G. Heating System: (As scheduled): UL listed electric resistance heater(s) with open wire Nichrome elements; high temperature limit switch, overcurrent protection; kw, voltage, phase and stages, as specified. Three phase heaters to be true, inherently balanced units.
- H. **Provide down discharge units with factory full perimeter curb to match roof slope. Curb to be a minimum of 18" curb, 14" above finish roof surface. Reference curb specification section.**
- I. Outdoor Air Intake: All RTU's **scheduled to have raw outside air intake** are to have an outside air intake hood with bee screen and an **Automatic**, 2-position outside air damper that is to operate during occupied periods and closed during unoccupied periods. Damper to have manually adjusted maximum set point. This is a minimum requirement. Check schedule for additional requirements. When economizers are scheduled provide with barometric relief unless fan powered exhaust is scheduled. Economizer, in high humidity weather, to be set at 55 degree drybulb for activation.
- J. **Dehumidstat: When unit is equipped with hot gas reheat coil, provide dehumidistat described above. When building has DDC system, unit is to be controlled by DDC sensor with appropriate controllers by Controls Contractor.**
- K. Provide direct drive fans with multi-speed taps or belt drive fans with adjustable sheaves. Motors need to be high efficiency. Provide maximum amount of adjustability to match job conditions. Provide multistage air volume/single zone VAV airflow for all multistage units.
- L. Provide with single point electrical power connection.

M. Manufacturers: Base Bid: Lennox Alternate Bid: Trane

2.05 EQUIPMENT SUPPORTS

A. Factory Support:

1. Welded minimum 16 gauge galvanized steel shell, base plate and counter flashing.
2. Factory installed wolmanized 2 x 4 wood nailer.
3. Internal bulkhead reinforcement.
4. **Constructed to match roof pitch.**
5. Minimum height to be 14" above finished roof.
6. Manufacturer: Thycurb Model TEMS-3 or equal.

B. Coordinate other roof supports with Architectural and Structural Drawings:

1. **Roof supports shall be provided and located by Mechanical Contractor. Roof supports shall be installed, flashed and counterflashed by the Roofing Contractor.**

PART 3 - INSTALLATION

3.01 Refrigerant piping shall be installed by licensed refrigeration Contractor. Size per Manufacturer's recommendation for length encountered. Size for minimal equipment capacity loss. Submit isometric drawing from the manufacturer indicating routing, sizes and velocity in piping and pressure drop in piping. Provide minimum four inch (4") diameter PVC sleeves as required for each refrigerant line set located under slab and through walls. Use 22-1/2° sleeve fittings for all underslab installation. Seal watertight top of PVC sleeves as they penetrate grade.

3.02 LIQUID LINE

- A. **Install moisture indicator/sight glass at each condensing unit.**
- B. Install properly sized filter-drier "in-line" type at each condensing unit if unit is not supplied with one. If unit is a heat pump, use bi-flow type drier.
- C. All valves, driers and indicators to be full line size and have sweat fittings.
- D. Maximum pressure drop in line shall be 10 psig. Size per manufacturer's written instructions.
- E. **Insulate entire liquid line (indoors and outdoors) on heat pump systems as recommended by the manufacturer.**

3.03 SUCTION LINE

- A. Every indoor coil (cooling and heat pump) shall be trapped when vertical rise is more than five feet (5'). When the compressor is below the evaporator, provide a trap in the suction line by coil, raise line to a point above coil and slope suction line down to compressor from that point. The trap shall be made up on one (1) short radius 90° trap and two (2) 45° fittings. For heat pumps, all horizontal vapor lines should be level.

- B. All rises in suction lines returning to compressor shall be trapped. Use double suction risers where necessary. All risers must maintain a minimum of 1000 fpm and a maximum of 3000 fpm. Line sized for a maximum of 3 psig pressure drop in system. Size per manufacturer's written instructions.
 - C. Insulate all suction lines, including the thermal bulb, from the thermal expansion valve. See insulation section for type and thickness.
- 3.04 The length of refrigerant line runs shall be kept as short as possible. It is preferred that they not exceed seventy feet (70') in running length, but in no one case should they exceed the cooling equipment manufacturer's recommendations.
- 3.05 All condensing units/heat pump units shall have neoprene vibration isolation pads mounted under each corner and sized per manufacturer's recommendations.
- 3.06 Circulate dry nitrogen throughout system during welding or brazing process.
- 3.07 Test all refrigerant piping and repair all leaks. Pressure test with dry nitrogen; use pressure reducing valve to limit pressure to 150 psig. After testing, evacuate and fully charge system with refrigerant per manufacturer's written instructions. Submit manufacturer's evacuation procedures with submittal.
- 3.08 General Contractor to provide level concrete pad for ALL GROUND MOUNTED hvac equipment, RTU,MAU,CU,HP, etc.. Verify actual size with equipment. Minimum 6" larger than equipment on all sides and connect to building when withing 36" of building.
- 3.09 Pack fiberglass insulation and sealing material, such as permagum, around refrigerant lines where they penetrate exterior building envelope.
- 3.10 VIBRATION ISOLATOR
- A. Provide vibration isolation at each air handling unit (AHU) or fan. Vibration isolators are to be rubber in shear type for suspended AHU's and Neoprene pads for floor mounted AHU's up to 5 tons. Isolators are to be sized for actual equipment purchased.
 - B. Manufacturers: Amber Booth, Vibration Mounting & Controls, Inc. or equal.
- 3.11 EQUIPMENT SUPPORTS AND ROOF CURBS
- A. Curb shall be manufactured in accordance with the National Roofing Contractors Association guidelines for rooftop equipment support.
 - B. Confirm exact roof curb installation requirements with Architectural flashing details. Coordinate installation requirements with roofing, structural and general contractors. Roof curb to extend above finished roof a minimum of 12", or 8" above highest point of cricket.
 - C. Roof deck to be cut out only where ducts penetrate roof. Provide 4" of rigid insulation (2 layers of 2" insulation with staggered joints) on roof deck below unit, topped by two layers of 5/8" exterior grade sheathing (densglass) or gypsum roof board (staggered joints) for sound attenuation.
 - D. Mechanical equipment to be secured to curb as required by code.
 - E. **High Wind Zones: Contractor shall be responsible for delegated design to secure ALL equipment/assemblies, ground or roof, so that they are secured/restrained per code for High Wind/Hurricane zones per the latest code maps.**

- F. In remodel situations, frame out under entire roof curb perimeter and all openings through roof with minimum 3" x 3" x 3/8" angle iron securely welded or bolted to existing structure, prior to cutting roof deck.
- G. Roof curbs on pre-engineered metal building are to be provided, installed and flashed and counter flashed by Pre-Engineered Metal Building Systems. Coordinate all requirements, dimensions, etc. with Pre-Engineered Metal Building Systems.

END OF SECTION

SECTION 23 70 70 – VRF HVAC SYSTEMS AND CONTROLS

PART 1 – GENERAL

VARIABLE REFRIGERANT FLOW (VRV-VRF) AIR CONDITIONING SPECIFICATION

1.01 SYSTEM DESCRIPTION

- A. Heat Pump 1 to 1 Option: The variable capacity, heat pump air conditioning system shall be a Variable Refrigerant Flow (heat and cool model) split system as specified. The system shall consist of evaporators paired with a single fan coil unit, piping joints and headers, refrigeration distribution system using PID control, and HP outdoor unit. The outdoor unit is a direct expansion (DX), air-cooled heat pump, air-conditioning system with variable speed inverter driven compressors using R-410A or R452 refrigerant. The outdoor condensing unit capacity should connect an appropriate indoor evaporator capacity. All zones are each capable of operating separately with individual temperature control.
- B. The outdoor unit shall be interconnected to indoor unit models that range in capacity from 7,500 Btu/h to 96,000 Btu/h. The indoor units shall be connected to the outdoor utilizing specified piping joints and headers. Each indoor unit or group of indoor units shall be independently controlled.
- C. Operation of the system shall permit either individual cooling or heating of each indoor unit simultaneously or all of the indoor units associated with one branch cool/heat selector box. Each indoor unit or group of indoor units shall be able to provide set temperature independently via a local remote controller, a VRV--VRF Centralized Controller or a DDC/BAS interface.
- D. Branch selector boxes shall be located as shown on the drawing. The branch selector boxes shall have the capacity to control up to 96 MBH (cooling) downstream of the branch selector box. The branch selector box shall consist of five electronic expansion valves, refrigerant control piping and electronics to facilitate communications between the branch selector box and main processor and between the branch selector box and indoor units. The branch selector box shall control the operational mode of the subordinate indoor units. The use of five EEV's ensures continuous heating during defrost, no heating impact during changeover and reduced sound levels.
- E. **Equipment manufacturer/vendor must submit written sequence of operation for all modes of operation for each piece of mechanical equipment with the equipment submittal. Give narrative explaining exactly what control signals are required to activate each mode of a particular unit's operation. Include information about which signals override others internally (when applicable). Submit this information with equipment submittal and provide a copy to the Controls Contractor so it can be integrated into the control scheme and control submittals. Indicate whether 24 VAC, 4-20 MA, 0-10VDC or line voltage is required for controls.**
- F. **Provide HVAC equipment with a controls interface that is suitable for connection to a standard conventional thermostat and/or non-proprietary DDC control systems unless it is SPECIFICALLY scheduled otherwise.**
- G. **Provide all information and participate in all meetings required by Equipment Start-Up, Test and Balance, Controls, and Commissioning Specification to ensure HVAC system is function properly, and passes Functional Testing during Commissioning of HVAC System.**
- H. SUBMITTALS:
1. Equipment submittals: reference section 23 70 00 – Mechanical equipment d – x systems.

2. Controls submittals: reference section 23 09 00 Controls (native BACnet) sub section 1.02. Provide submittal information for all items provided by VRV-VRF manufacturer.

I. COMMISSIONING REQUIREMENTS:

1. Contractor required to show compliance with code required and Owner required commissioning scope.
2. Contractor to obtain a Fieldwire Pro software license or other software license required by Commissioning Agent for the duration of the project commissioning.
3. **Provide all information and participate in all meetings required by Equipment Start-Up(Record ALL Field Settings), Test and Balance, Controls, and Commissioning Specification to ensure HVAC system is function properly, and passes Functional Testing during Commissioning of HVAC System.**

1.02 EQUIPMENT REQUIREMENTS

- A. Voltage Platform – Condensing units shall be available with a 460V/3/60, 208/230V/3/60 and 208/230V/1/60 power supply. Some features only available on three phase outdoor units.
- B. Auto-charging – Each system shall have a refrigerant auto-charging function.
- C. Charge Checking – Each system shall have a refrigerant charge checking function.
- D. Defrost Heating – Each system shall maintain continuous heating during defrost operation. If system is not capable of continuous heating during defrost supplier shall add supplemental heat strips at no additional cost to the owner; must coordinate with Electrical Engineer and Electrical Sub Contractors prior to bid
- E. Oil Return Heating – Each system shall maintain continuous heating during oil return operation. If system is not capable of continuous heating during oil return supplier shall add supplemental heat strips at no additional cost to the owner; must coordinate with Electrical Engineer and Electrical Sub Contractors prior to bid
- F. VFD Inverter Control – Each condensing unit shall use a high efficiency, variable speed “inverter” compressor coupled with inverter fan motors. Digital scroll compressors are not acceptable.

1.03 QUALITY ASSURANCE

- A. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL), in accordance with ANSI/UL 1995 – Heating and Cooling Equipment and bear the Listed Mark.
- B. All wiring shall be in accordance with the National Electric Code (NEC).
- C. The system will be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.
- D. Mechanical equipment for wind-born debris regions shall be designed in accordance with ASCE 7-2002 and installed to resist the wind pressures on the equipment and the supports.
- E. The outdoor unit will be factory charged with R-410A.
- F. All capacities and efficiencies shall be rated in accordance with AHRI.

PART 2 – WARRANTY

2.01 WARRANTY

- A. The units shall have the manufacturer's parts warranty for a period of ten (10) years from date of installation. All compressors shall have a parts warranty of ten (10) years (total) from date of installation. All warranty service work shall be performed by a factory trained service professional. Warranty shall be administered by the manufacturer or local manufacturer's representative. All service persons shall be factory trained and certified with a minimum of 3 years documented experience with the installed manufacturer's equipment. If the manufacturer or local distribution representative does not have a local service department, then the contractor shall assume all warranty obligations during this period. If warranty is a "contractor warranty" then it shall be clearly indicated in the equipment submittal. The contractor's factory certification shall be provided in the equipment submittal. Warranty cannot be reduced during submittal.

2.02 INSTALLATION REQUIREMENTS

- A. The system must be installed by a factory trained contractor/installer. Start-up must be by Factory Personnel. The bidders shall be required to submit training certification proof prior to award of contract. Should the installing contractor use a manufacturer other than the basis of design, all coordination related to differences between basis of design and the alternate manufacturer shall be the responsibility of the installing contractor including any required additional evaluation requirements by the engineering firm at current hourly rates.
1. Factory Certified witness of breaking of line set vacuum.
 2. Factory QC Walks with installing contractor at the following intervals:
 - a. Pre-piping and wiring
 - b. Twice during piping rough-in, and wiring rough-in
 - c. During Vacuum and pressure testing
 - d. Pre-startup
 - e. Keep Log of Factory Personnel Visits with Date and Person walking.
 3. Full Factory Start-up Required
 - a. Service Checker data and temperatures for all fan Coil
 - b. Piping Lengths with additional refrigerant required
 - c. Visual Inspection for cleanliness
 - d. Verify and change all (Field Settings) factory default setting in ALL controllers to meet job requirements. Provide spreadsheet/start-up forms Listing ALL settings checked/changed with signature of person performing programing changes. Must be recorded and provided to Engineer with Start-up and CX information.
 - e. Factory Start-up personnel are required for verification to Job Commissioning Agent on a separate visit from start-up.

f. **Reference “Start-Up Report Verification” in the General Provisions Specification.**

4. VRV-VRF Service Checker and Inverter analyzer tools to be conveyed to owner at closeout
5. Wiring: All wiring to be per factory installation instructions. All systems to be wired to accept VRV-VRF Central Controller in future even if not installed in current job.
6. Manufacturer to offer 24 hours of onsite training to site based service and maintenance personnel. Topics to cover basic maintenance, trouble shooting and diagnostic data interpretation.

2.03 PARTS AVAILABILITY

- A. The installed system shall have a minimum of one local parts distributor with local (within 90 miles) stock of all critical components. Local availability shall include all fan blades, fan motors, compressors, circuit boards, valves, sensors, etc. If local stock of parts is not available, the manufacturer shall provide all warranty parts with next day freight availability at no additional cost to the owner for 5 years. Unless parts are stocked locally, the owner shall be provided with the following spare parts at no additional cost (to be delivered at startup):
1. Compressor of each size used on the project
 2. Fan blade for each style used on the project (condenser and all FCU)
 3. Circuit board for each model FCU and ACCU used

PART 3 – PERFORMANCE

3.01 DESIGN BASIS

- A. The HVAC equipment basis of design is **Daikin** AC.
- B. Alternate Pre-approved manufacturer: **Mitsubishi Electric** (provide as separate alternate price)
- C. All bidders shall furnish the minimum system standards as defined by the base bid model numbers, model families or as otherwise specified herein (see Key General Specifications Alternate Supplier Checklist). In any event, the contractor shall be responsible for all specified items and intents of this document without further compensation.
- D. Alternate manufacturers from those listed above may be acceptable provided items detailed in Part 5 VRV-VRF HVAC EQUIPMENT ALTERNATE, are met.

PART 4 – PRODUCTS

4.01 OUTDOOR/CONDENSING UNIT

- A. Outdoor/Condensing units: Air-cooled DX refrigeration units, designed specifically for use with indoor/evaporator units; factory assembled and wired with all necessary electronics and refrigerant controls; modular design for ganging multiple units.

1. Refrigeration Circuit: Scroll compressors, motors, fans, condenser coil, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut-off valves, oil separators, service ports and refrigerant regulator.
 2. Refrigerant: Factory charged.
 3. Variable Flow Control: Modulate compressor capacity automatically to maintain constant suction and condensing pressure while varying refrigerant flow to suit heating/cooling loads.
 4. Capable of being installed with wiring and piping to the left, right, rear or bottom.
 5. Capable of heating operation at low end of operating range as specified, without additional low ambient controls or auxiliary heat source; during heating operation, reverse cycle (cooling mode) oil return or defrost is not permitted due to potential reduction in space temperature.
 6. Power Failure Mode: Automatically restart operation after power failure without loss of programmed settings.
 7. Provide refrigerant auto-charging and refrigerant charge check functions.
 8. Safety Devices: High pressure sensor and switch, low pressure sensor/switch, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-cycling timers.
 9. Provide refrigerant sub-cooling to ensure the liquid refrigerant does not flash when supplying indoor units.
 10. Oil Recovery Cycle: Automatic, occurring 2 hours after start of operation and then every 8 hours of operation; maintain continuous heating during oil return operation.
 11. Controls: Provide contacts for electrical demand shedding.
- B. Unit Cabinet: Weatherproof and corrosion resistant; rust-proofed mild steel panels coated with baked enamel finish.
1. Designed to allow side-by-side installation with minimum spacing.
 2. Outdoor Units are to be installed with a minimum of 24" clearance between units, this includes multiple module units. Provide manufacturers required clearances if greater than 24".
 3. Side discharge units are to be located so that one unit does not discharge toward the inlet of another unit. Provide accessory that diverts the discharge air up.
- C. Fans: One or more direct-drive propeller type, vertical discharge, with multiple speed operation via DC (Digitally Commutated) inverter.
1. External Static Pressure: Factory set at .12" WG, minimum. Capable of up to .32" WG External Static Pressure
 2. Fan Airflow: As indicated for specific equipment.

3. Fan Motors: Factory installed; permanently lubricated bearings; inherent protection; fan guard; output as indicated for specific equipment.
- D. Condenser Coils: Copper tubes expanded into aluminum fins to form a mechanical bond; waffled louver fin and rifled bore tube design to ensure high efficiency performance.
- E. Compressors: Scroll type, hermetically sealed, variable speed inverter-driven suit total capacity; minimum of one variable speed, 2 compressor units shall have dual variable speed scroll compressors, Unit shall modulate from 10 percent to 100 percent of total capacity.
1. Variable Speed Control: Capable of changing the speed to follow the variations in total cooling and heating load as determined by the suction gas pressure; high/low pressure calculated by samplings of evaporators and condenser temperatures every 20 seconds, with compressor capacity adjusted to eliminate deviation from target value by changing inverter frequency or on/off setting of fixed speed compressors.
 2. Multiple Condenser Modules: Balance total operation hours of compressors by means of duty cycling function, providing for sequential starting of each module at each start/stop cycle, completion of oil return and completion of defrost, or every 8 hours.
 3. Failure Mode: In the event of compressor failure, operate remaining compressor(s) at proportionally reduced capacity; provide microprocessor and associated controls specifically designed to address this condition.
 4. Inverter Driven Compressors: PWM inverter driven, highly efficiency reluctance DC (Digitally Commutated), hermetically sealed scroll with maximum speed of 7,980 rpm.
 5. Rotors: Incorporating neodymium magnets for higher torque and efficiency; at complete stop of compressor, position rotor into optimum position for low torque start.
 6. Provide each compressor with crankcase heater, high pressure safety switch and internal thermal overload protector.
 7. Provide oil separators and intelligent oil management system.
 8. Provide spring mounted vibration isolators.
 9. Hail Guards, Boxed Metal type painted to match the unit, wire mesh is unacceptable. All Outdoor unit must have hail guard installed.

4.02 BRANCH SELECTOR UNITS (as required)

- A. Branch Selector Units: Concealed boxes designed specifically for this type of system to control heating/cooling mode selection of downstream units; consisting of electronic expansion valves, sub cooling heat exchanger, refrigerant control piping and electronics to facilitate communications between unit and main processor and between branch unit and indoor/evaporator units.
1. Control direction of refrigerant flow using electronic expansion valves. Solenoid valves are not allowed due to noise and reliability issues. Use of multi-port branch selector boxes is permitted; provide spare ports for redundancy.
 2. When branch unit is simultaneously heating and cooling, energize sub cooling heat exchanger.

3. Casing: Galvanized steel sheet; with flame and heat resistant foamed polyethylene sound and thermal insulation.
4. Refrigerant Connections: Braze type.
5. Label all ports with air handling unit number that it serves.

4.03 ZONE DAMPER UNITS (as scheduled on plans)

- A. Zone Damper Unit shall include Zone Box, Control Board, Interface Board and be completely compatible in every way mechanically and controls with VRV-VRF manufacture equipment.
- B. Size to match zone
- C. Provide All materials and Programing to complete system.

4.04 INDOOR/EVAPORATOR UNITS

- A. All Indoor/Evaporating Units: Factory assembled and tested DX fan-coil units, with electronic proportional expansion valve, control circuit board, factory wiring and piping, self-diagnostics, auto-restart function, 3 minute fused time delay and test run switch.
 1. Refrigerant: Refrigerant circuit factory-charged with dehydrated air, for field charging.
 2. Temperature Control Mechanism: Return air thermistor and computerized Proportional-Integral-Derivative (PID) control of superheat.
 3. Coils: Direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond; waffled louver fin and high heat exchange, rifled ore tube design; factory tested.
 - a. Provide thermistor on liquid and gas lines.
 4. Fans: Direct-drive with statically and dynamically balanced impellers; high and low speeds unless otherwise indicated; motor thermally protected.
 5. Return Air Filter: Washable long-life net filter with mildew-proof resin, unless otherwise indicated.
 6. Outside Air Fan Coil Units are to have 2" disposable panel filters installed in a filter box with a hinged assess door.
 7. Condensate Drainage: Built-in condensate drain pan with PVC drain connection.
 - a. Units With Built-In Condensate Pumps: Provide condensate safety shut-off and alarm
 - b. Units Without Built-In Condensate Pumps: Provide manufacturer recommended external condensate pump, minimum 10ft of head. See Drawings for required flowrate. Provide with built-in condensate float switch and wiring connections for condensate safety shut-off and alarm.
 8. Cabinet Insulation: Sound absorbing foamed polystyrene and polyethylene insulation.

- B. Recessed Ceiling Units – 3'x3' Four-way airflow cassette with central return air grille, for installation in a fixed ceiling.
1. Face Size: 33" square, nominal.
 2. Cabinet Height: Maximum of 10" above face of ceiling.
 3. Exposed Housing: White, impact resistant, with washable decoration panel.
 4. Supply Airflow Adjustment:
 - a. Via motorized louvers which can be horizontally and vertically adjusted from 0 to 90 degrees.
 - b. Field-modifiable to 3-way or 2-way airflow.
 - c. Three auto-swing positions, including standard, draft prevention and ceiling stain prevention.
 5. Return Air Filter: Manufacturer's standard.
 6. Minimum Capacity: As indicated on the drawings.
 7. Fan: Direct-drive turbo type
 8. Built in Occupancy Sensor
 9. Condensate Pump: Built-in, with lift of 21 inches, minimum.
 10. Provide side-mounted supply air branch duct connection.
- C. Recessed Ceiling Units – 2'x2' Four-way airflow cassette with central return air grille, for installation in standard 24"x24" lay-in ceiling grid.
1. Cabinet Height: Maximum of 12" above face of ceiling.
 2. Exposed Housing: White, impact resistant, with washable decoration panel.
 3. Supply Airflow Adjustment:
 - a. Via motorized louvers which can be horizontally and vertically adjusted from 0 to 90 degrees.
 - b. Field-modifiable to 3-way or 2-way airflow.
 - c. Three auto-swing positions, including standard, draft prevention and ceiling stain prevention.
 4. Return Air Filter: Manufacturer's standard.
 5. Minimum Capacity: As indicated on the drawings.
 6. Fan: Direct-drive turbo type
 7. Condensate Pump: Built-in, with lift of 21 inches, minimum.

8. Provide side-mounted supply air branch duct connection.
- D. Concealed-In-Ceiling Units: Ducted horizontal discharge and return; galvanized steel cabinet.
1. Return Air Filter: Manufacturer's standard.
 2. Motor shall be ECM
 3. Provide external static pressure switch, adjustable for high efficiency filter operation.
 4. Condensate Pump: Built-in, with lift of 9", minimum.
 - a. For units without built-in pump capability, provide manufacturer recommended external pump with float switch and wiring for condensate safety shut-off and alarm. See drawings for required flow rate (minimum 10ft of head).
 5. Switch box accessible from side or bottom.
 6. Manufacture shall provide 2" Filter Rack with both side and bottom access doors
- E. Wall Surface-Mounted Units: Finished with white casing, with removable front grille; foamed polystyrene and polyethylene sound insulation; wall mounting plate; polystyrene condensate drain pan.
1. Airflow Control: Auto-swing louver that closes automatically when unit stops; five (5) steps of discharge angle, set using remote controller; upon restart, discharge angle defaulting to same angle as previous operation.
 2. Condensate Drain Connection: Back, with piping concealed in wall.
 3. Fan: Direct-drive cross-flow type.

PART 5 – VRV-VRF HVAC EQUIPMENT ALTERNATE (GENERAL INFORMATION)

- 5.01 Pre Approved Alternate Manufacture does not have to follow 5.01-5.03, as they are pre-approved. They must however identify all electrical upgrades required with a statement acknowledging they are covered in alternate price. No additional money will be given for changes required (electrical, plumbing, architectural, etc.) by any alternate system.
- 5.02 All other alternate equipment supplier shall provide to the Mechanical Engineer 15 Days prior to bid day a complete equipment data package.
- 5.03 The submitted documents shall be complete system designs and show no less information than the HVAC equipment/controls contract bid documents.
- A. *Additional Items for submission that is required in addition to the above:
1. References of 5 VRV-VRF Applications within 100 mile radius of this job site, must include type of product on project, along contact phone numbers.
 2. Comply/ No-Comply statement to address each item in specification.
 3. For comparison purposes all equipment files are to be provided to engineer as BIM Object files in Revit format.

4. AHRI data sheets shall be provided to verify certification.
5. Identify any electrical upgrades required and a statement verifying that all electrical upgrades required are covered in alternate system bid.

5.04 Submitted information shall include de-rates for line lengths, specified ambient conditions, connection ratio and any other job specific conditions. Standard catalog data is not acceptable.

PART 6 – CONTROLS

6.01 CONTROLS – INDIVIDUAL WALL MOUNTED CONTROLLER

- A. Each unit shall be supplied with a wall mounted thermostat controller (newest version). The controller shall have a backlit LCD display and be able to support the following display items and user input operations:
 1. On/Off control
 2. Manual change of mode of operation
 3. Set point adjustment
 4. Reading of both heating and cooling set point temp
 5. Reading of actual room temp
 6. Fan speed setting
 7. Mode of operation on the unit display
 8. Individual Heating and Cooling (dual) set point adjustment
- B. The controllers shall be capable of diagnostic use and provide malfunction codes to indicate the type of failure that has occurred. The user shall be able to read superheat temperatures, return air and discharge air temperature values directly from the wall mounted thermostats.
- C. The controllers shall be capable of accepting independent set points for cooling and heating operation. The use of a common set point is not allowable.
- D. The system shall provide automatic change-over from heating to cooling mode of operation. If, in heating mode, the space temperature rises 1 degree above the cooling set point, the system shall change from heating to cooling mode. If, in cooling mode, the space falls 1 degree below the heating set point, the system shall change from cooling to heating mode. Auto-change-over is required for all systems (heat pump and heat recovery). If not available in heat pump system, then manufacturer must provide system capable of meeting this requirement.
- E. Adjustable setback temperature – The controllers shall allow for independent and adjustable setback temperature at each unit. The setback temperature (adjustable) shall determine the “override” temperature to start the system when in setback mode if the temperature rises or falls outside of the specified range.
- F. Where VRV-VRF systems are specified with electric heaters (external), the wall mounted controllers shall directly control the external heater. The electric heat shall be considered the primary heating source unless the central controller is used to provide an alternate control strategy.

6.02 VRV-VRF CENTRAL CONTROLLER

- A. The VRV-VRF central controller intended to:
1. Provide centralized network control of ALL VRV-VRF systems.
 2. Provide offsite network web access. Web access functions shall be available so that facility staff can securely log into system via the PC's web browser to support monitoring, scheduling, error email, and general user functions
 3. When 3rd Party BAS is on project, this controller provides BACnet communication.
 4. Provide visibility to ALL BACnet points, programmability for setpoints and scheduling.
 5. Provide most current version of hardware and software.
 6. Reference Specification 23 09 00 Controls for additional information.
 7. Basis of Design to match Manufacture
 - a. Daikin – I-Touch Manager
 - b. Mitsubishi – Diamond Controls Advanced Integration Panel
- B. The VRV-VRF Central Controller shall provide the following:
1. Central control of set points, schedules, airflow rates, heat/cool mode
 2. Adjustable control of setback (override) temperature settings during unoccupied periods
 3. Adjustable temperature limits to restrict local wall mounted thermostat set point ranges.
 4. Scheduling of zones and individual units (separate schedules for MAU's).
 5. Visible and audible alarm indication of any system malfunctions with descriptive error code.
 6. Computer Display to be located in space designated by Architect/Engineer.
 7. External Digital input/output and display of external input values.
 8. External Analog input/output and display of external input values
 9. Tiered hierarchy allowing for control of fan coil units independently or as a group.
 10. Remote disable of individual functions of the wall mounted controllers.
 11. The Central Controller shall perform the control sequencing as detailed below.
 12. Floor Plan Layout see below
 13. (6) Auxiliary Digital Input / Analog outputs to be provided for lighting control, if designated in construction drawings.

14. Controller to Web Accessible. Coordinate data drop and IP Address with Technology Contractor/Owner.
 15. When VRV-VRF Central Controller is the main BAS for Building. Provide additional expansion modules as needed to control 3rd party non VRV-VRF equipment if required on job and provide Floorplan Layout and Graphics.
- C. 3rd Party BAS/DDC System Integration: Variable Refrigerant Flow equipment must provide factory and local site support and comply to the following:
1. Provide Licensed Interface software and cabling needed to allow a direct connection into main controller for diagnostics.
 2. Full free factory support will be always available with provided phone numbers and contacts.
 3. Full support will be provided to 3rd Party BAS/DDC controls technicians to provide a seamless BACNET interface.
 4. Provide a minimum of BACNET interface points as follows:
 - a. Abbreviations: IU (IU), OU (OU), AV (Analog Value), BV (Binary Value), MSV (Multistate Value).
 - b. IU Discharge Air Temperature °F: Read AV
 - c. IU Room Temperature °F: Read AV
 - d. IU Room Humidity: Read AV
 - e. IU Room Temperature Set-Point °F: Read/Write AV
 - f. IU Timed Override Limit: Write AV
 - g. IU Active Timed Override: Read AV
 - h. IU Communication status: Read BV
 - i. IU Alarm Code: Read AV
 - j. IU Remote Thermo-Sensor User Lockout: Write BV
 - k. IU Show/Hide Space Temperature on Display: Write BV
 - l. IU Show/Hide remote head display: Write BV
 - m. IU Fan Status: Read BV
 - n. IU AUX Heater Status: Read BV
 - o. IU Air Flow Speed: Read/Write MSV
 - p. IU Filter Dirty Status: Read BV
 - q. IU Filter Dirty Clear: Write BV

- r. IU Operating Status (Operating or Non-Operational): Read BV
- s. IU Current Activity Cooling or Heating State: Read BV
- t. IU Force the IU to Stop Actively Cooling or Heating: Write BV
- u. IU Operation Mode (Cooling, Heating, Fan, Auto): Read/Write MSV
- v. IU Occupancy Mode (Occupied, Unoccupied, or Standby): Read/Write MSV
- w. IU Occupied Cooling Set-point: Read/Write AV
- x. IU Occupied Heating Set-point: Read/Write AV
- y. IU Un-Occupied Cooling Set-point: Read/Write AV
- z. IU Un-Occupied Heating Set-point: Read/Write AV
- aa. IU Maximum Cooling Set-point Limit: Write AV
- bb. IU Minimum Heating Set-point Limit: Write AV
- cc. IU Minimum Set-point Differential Cooling/Heating: Write AV
- dd. IU Permit/Prohibit the remote controller to control the IU ON or OFF: Write BV
- ee. IU Permit/Prohibit the remote controller to control the IUs Operations mode: Write BV
- ff. IU Permit/Prohibit the remote controller to control the IUs Set-point. Write BV
- gg. OU Mode Status: Read BV
- hh. OU Alarm Codes: Read MSV
- ii. OU Compressor run status: Read BV
- jj. OU High Pressure PSI: Read AV
- kk. OU Low Pressure PSI: Read AV
- ll. OU Suction Temperature °F: Read AV
- mm. OU Liquid Pipe Temperature °F: Read AV
- nn. OU Heat Exchanger Temperature °F: Read AV
- oo. OU EEV %: Read AV
- pp. OU Sub-cool EEV °F: Read AV
- qq. OU Hot-gas Valve position: Read BV
- rr. OU Inverter Discharge Temperature °F: Read AV

- ss. OU Outdoor Temperature °F: Read AV
 - tt. OU Operation Mode: Read MSV
 - uu. Thermostat Head must be as basic as can be to allow the above functions (preferably non-display).
- D. VRV/VRV-VRF Units (Stand Alone Option – no BacNet – individual heat pumps) – DDC or – 7day stat – Pelican Style
- 1. Stand Alone VRV-VRF Heat Pumps with Factory T-stat – for unit setup and error codes, place above ceiling for maintenance.
 - 2. **Provide 3rd PARTY DDC T-STAT INTEGRATION:**
 - a. **PROVIDE DKN PLUS INTERFACE “AIRZONE PART# AZAI6WSPDKC”, or equal.**
 - 3. **3RD PARTY DDC: Provide DDC Sensor with Temp and RH to match OWNER standard. Connect DDC sensor to interface module.**
 - a. **Move Existing Unit manufacture sensor above ceiling for future programing and error code reference.**
 - b. **Provide BAS controller for each of these units.**
 - c. **Provide Discharge Air sensor.**
 - 4. BAS to provide controllers and sensors described to provide heating and cooling sequences similar to of the heat pumps on project, as well as duct mounted temperature sensor to monitor discharge air temperature. Mount sensor approximately five feet downstream of unit in accessible location. Provide humidistat above each thermostat. Humidistat to energize
 - 5. AHU “Dry Mode” whenever humidity exceeds 55% RH (adjustable by Owner).
 - 6. **Thermostat NON DAIKIN 7-DAY PROGRAMABLE:** (Only applies when DDC not desired and owner doesn’t want Daikin Stats visible.)
 - a. Pelican Wireless Thermostat (TC series) **TC4** (Temp,RH,CO2) **and Pearl module** to provide discharge air and additional functionality(ALL UNITS). Wi-Fi enabled with free mobile apps and easy to use Web Portal. Thermostat to have touch screen, 365 day scheduling and 7 day programmability. Thermostat to have up to 4 heat stages and up to 2 cool stages. Provide with 2 hour override and dehumidification capability.
 - b. Ethernet Gateway (GW400) locate in IDF room.
 - c. Set all points to trend historical data for max time allowed.
 - d. Chip Parish – 832-823-9523 – chip@pelicanwireless.com

6.03 FAN COIL UNIT CONTROL SEQUENCE

- A. Each room with a unit shall have a wall mounted controller (unless noted on plans). Rooms with multiple units shall use a common wall mounted controller as indicated on the drawings. The central controller shall limit the high and low set point limits (as determined by the owner/engineer at start-up). The central controller shall overwrite any set point that is out of range. For purposes of initial programming at Factory Start-up, the system will limit cooling set points between 70-75°F and Heating set points between 67-70°F. Each zone shall control to the active set point temperature on the wall mounted controller. The schedule of operation hours shall be controlled by the central controller.
- B. The heating and cooling modes shall be controlled by the VRV-VRF Central Controller. The manual MODE selection at the individual wall mounted controllers shall be disabled. The central controller shall monitor the room temperatures in each zone. If any zone's temperature exceeds 74 degrees, then cooling will be enabled and the heating will be disabled for all fan coil units in the condensing unit's (or branch selector's) group. Likewise, if any zone's room temperature falls below 68 degrees, then the heating will be enabled, and cooling will be disabled. The heat/cool mode selection by the VRV-VRF central controller shall not override the on/off schedule or setback temperature range availability.
- C. Discharge Air in Cooling mode should be 55 degrees Fahrenheit or below, discharge air in Heating Mode should be 95 degrees Fahrenheit or above. Fan should be in Auto, Fan should only run when unit is heating or cooling. Outside Air Damper should only be open during heating or cooling during occupied schedule and there is a CO2 if CO2 is monitored, ALL other times OA Damper should be closed. (Remove any factory presets that prohibit discharge air in cooling to be 55 or cooler.)
- D. VRF units REQUIRE – Factory Field Setting documentation of Actual Final setting on each unit in field. Must be documented, not just checked-off and submitted for records. Reference plans for additional information.
- E. AHU-OA: Outside Air VRV-VRF units should discharge air at 55 degrees Fahrenheit or colder off cooling coil then should reheat air to approx. 72 degrees Fahrenheit with Electric Heat or Hot Gas Coil depending on job. Outside Air unit shall have separate dedicated programable OA occupied/OA unoccupied schedule.
- F. During unoccupied operation, the VRV-VRF central controller shall provide adjustable setback temperature set point. During unoccupied time, the systems shall be defaulted off, but shall automatically start and begin to cool/heat if the user adjustable limits are exceeded.
- G. The VRV-VRF central controller shall facilitate additional expansion by the owner at a later time by being compatible with both digital and analog input/output devices.

PART 7 – OWNER TRAINING

7.01 OWNER TRAINING

- A. The equipment supplier shall provide the owner's maintenance department with a minimum of 6 hours of classroom and hands-on training on the system including the following:
 - 1. Review and understanding of the fan coil and condensing unit equipment components.
 - 2. Review of manufacturer's piping and control wiring schematics & architecture.

3. Review of the CU/FCU control and operation sequence of operations and review of error code descriptions.
 4. Review of startup procedure, shutdown/restarting procedures, refrigerant charging procedures.
 5. Troubleshooting and diagnostic procedures.
 6. Disassembly of the fan coil types provided for this project.
 7. Central Controller orientation and configuration including:
 - a. Navigation
 - b. Setting Schedules
 - c. Changing set points and control of units
 - d. Hierarchy of system setup
- B. Training shall be available either on-site or at a manufacturer's authorized training center within 200 miles. If a training center is not available within 200 miles, then the manufacturer or representative office shall include the cost of airfare for up to 6 maintenance persons.

END OF SECTION

SECTION 23 99 95 – COMMISSIONING OF MECHANICAL SYSTEMS

PART 1 - GENERAL

1.01 COMMISSIONING AGENCY (CA)

- A. Commissioning is code required for this project.
- B. The CA has overall responsibility for planning and coordinating the commissioning process. However, commissioning involves all parties from the design and construction process, including the mechanical (Division 23) contractor, and all specialty sub-contractors within Division 23, such as sheet metal, piping, refrigeration, water treatment, and controls, plus major equipment suppliers as required.

1.02 CONTRACTOR RESPONSIBILITY

- A. Contractors involved in Commissioning process.
 - 1. General Contractor
 - 2. Mechanical Contractor
 - 3. Controls Contractor
 - 4. Test and Balance Contractor
 - 5. Unit Manufacturer Representative / Start-up Technician.
 - 6. Electrical Contractor
- B. Contractors will be responsible for working with Commissioning Agent for performance verification and validation of new system installation of HVAC system to ensure it meets the intent Engineering Documents.
- C. Contractor will be required to complete all equipment Start-Up / Pre-Functional Forms.
 - 1. Contractor required to use Online Commissioning Software. Coordinate exact Software with Commissioning Agent.
 - 2. Fulfill documentation requirements.
 - 3. Upload all commissioning information required.
 - 4. Add and complete checklist in commissioning software as required.
 - 5. Update progress.
 - 6. Keep up to date software license for duration of commissioning scope.
 - 7. Visit www.fieldwire.com, for sample information. (sample software licenses cost)
- D. Contractor will be required to meet together with Commissioning Agent:
 - 1. Pre-Installation Meeting

2. Initial equipment Start-Up Onsite with Technicians
 3. Together Onsite as needed to perform Validation Test.
 4. Failure to attend these meetings will result in \$500 penalty to be withheld from retainage.
- E. Failure to perform will result in withholding of final payment. This includes:
1. Failure to accurately complete all required equipment Start-Up and Pre-Functional Forms.
 2. Failure to provide accurate Test and Balance.
 3. Failure to provide passing Validation Testing.
- F. Reference project specifications for requirements: 23 08 02 Equipment Start-Up, 23 05 93 Test and Balance, 23 09 00 Controls, and Commissioning Agent software for Pre-functional list when appropriate.

END OF SECTION

SECTION 26 05 00 - GENERAL

PART 1 – GENERAL

1.01 SCOPE OF WORK

Unless otherwise specified, provide all labor, equipment, supplies, materials, superintendence and testing necessary for the installation of complete electrical systems as required by these specifications and as shown on the Drawings, subject to the terms and conditions of the contract. Complete such details of electrical work not mentioned or shown which are necessary for the successful operation of all electrical systems described on the Drawings. Include empty conduits as required for all special systems and power for condensate pumps and HVAC control panels as required by the Mechanical Contractor. Field coordinate exact locations.

- A. Submit a bid on the basis of a complete installation, including all labor, material, cartage, insurance, permits, associated fees and taxes.
- B. Include temporary electrical power and lighting that will be required for the interior of the buildings. Provide lighting to satisfy OSHA requirements and the NEC.
- C. All Agreement Forms, General Conditions, Supplementary Conditions, and Division 1 of the specifications shall apply to the work specified in Division 26-28.
- D. Additional Site Visit Costs: The Contractor shall be charged with any cost resulting from uncompleted items that require additional site trips by the Architect/Engineer.
- E. No attempt has been made to show complete design details of building construction on the Electrical plans. Refer to Architectural, Structural and Mechanical plans for additional details which will affect electrical work. No extra cost will be allowed for offsets in conduit and wiring to avoid other work or when minor changes are necessary to facilitate installation or maintenance.
- F. Electrical Contractor is to provide all parts and labor to make final connections to all equipment shown in contract documents. Power may be shown in general location, it is expected that Electrical Contractor coordinate final locations for rough-in and connection requirements with exact equipment being installed. These items include but not limited to book security, exhaust fans, kilns, hand dryers, sensor operating plumbing devices, overhead doors, powered curtain, fire alarm door hold opens, etc.
- G. **NO TOXIC NOR HAZARDOUS MATERIALS, INCLUDING BUT NOT LIMITED TO PRODUCTS OR MATERIALS CONTAINING ASBESTOS, PCB AND LEAD SHALL BE PROVIDED OR INSTALLED.**
- H. An extra copy of all field reports shall be kept in a separate notebook. Contractor to set up in the Construction Manager's trailer. These reports shall be used for Contractor to check that each individual item noted has been completed. Also keep log of where extra receptacles and outlet boxes called out in 26 27 26, 3.01 and 26 05 80, 2.01. are installed.
- I. **Electrical Contractor shall use Fire Alarm Contractor's Shop Drawings and Rough-In details on drawings for rough-in of all fire alarm devices. Any devices not roughed-in according to Fire Alarm Shop Drawings and drawing details shall be relocated at no cost to Owner.**

- J. Sensor Operated Plumbing Devices: Plumbing Contractor to provide transformers from manufacturer. Electrical Contractor to provide all other electrical materials and labor to provide complete and workable device. This includes but is not limited to receptacles for plug in transformers, line voltage wire/conduit for direct connect low voltage transformers, all low voltage plenum rated 16-gauge wire.
- K. **Cad Drawings:**
1. **Architectural Background Files – Architectural Files are background files; MEP drawings are not background files.** To insure the most current Architectural files are used for shop drawings backgrounds, they must be obtained from the architect and cannot be given from the engineer. Reference Architect for cost of Architectural Files.
 2. **MEP Drawings** – These drawings cannot be used for shop drawings, as they are diagrammatic in nature only. Actual shop drawings prepared by sub-contractors must be used for coordination between all trades. If MEP floorplan files are requested, they may be obtained with a signed confidentiality release form, only as outlined below. These files may be used in conjunction with this project only. There are no guarantees of compatibility or accuracy; all technical support will be billed hourly at current Engineer's Rates. Engineer does not charge for actual file but does charge for time required to prepare the files in format as requested by the Contractor. Fees will be based on Engineer's current hourly rates. Deposit of \$500 must be paid prior to beginning file preparation and balance must be paid prior to release of any files. Total fee based on actual time required by Contractor's request. See submittal and shop drawing section for additional information.
 3. **MEP CAD Files that will be released.**
 - a. If no Architectural RCP is available for light locations, Lighting Floorplans will be released.
 - b. Mechanical Floorplan will be released to Mechanical Contractor for aid in production of his own shop drawings. HCE mechanical drawings may not be submitted as shop drawings.
 - c. Fire Alarm/Fire Sprinkler/Intercom etc... Contractors must use Architectural Revit Models and CAD files for backgrounds and Architectural RCP's (when available or lighting floorplan) and **Mechanical Contractor Shop Drawings** for coordination purposes. This must be obtained from Architect. Engineer may not release architectural drawings.
 4. Reference "**HCE BIM Protocols**" – document attached to the end of this section. It defines the expectations, limits and level of development of any 3D design tool, (if used) for any portion of a project design, to develop 2D bid documents. This applies to 3D design tool used by design teams as well as 3D design tool that may be requested by Contractor.
- L. **Site observation communication between Engineer and Contractors will be using online software. Contractors required to obtain a Fieldwire Pro Software License of other software license required by MEP Engineer for the duration of the project. This software will be used to generate and respond to Field Reports. Contractors required to carry license for duration of project. Reference 3.12.**

- M. The Contractor binds himself, his partners, successors, assigns and legal representatives to the Owner hereto in respect to all covenants, agreements and obligations contained in the Contract Documents. The Contractor shall not assign the Contract, or sublet it as a whole, without the written consent of the Architect/Owner, nor shall the Contractor assign any monies due or to become due to him hereunder, without the previous written consent of the Owner/Architect.
- N. The Contractor shall supervise and direct the Work using his best skill and attention. He shall be solely responsible for all construction means, methods, techniques, safety, sequences and procedures and for coordinating all portions of the Work under his Contract.
- O. The Contractor shall provide, without extra charge, all incidental items required as a part of the Work, even though not particularly specified or indicated, and if he has good reason for objecting to the use of a material, appliance, or type of construction shown or specified, he shall register his objections with the Architect/Engineer, in writing; otherwise, he shall proceed with the work under the stipulation that a satisfactory job is required.
- P. Provide a completed Schedule of Values, see Specification Section 26 05 10. Preliminary schedule of values shall be submitted to Architect/Engineer for review.

1.02 SITE INSPECTION

- A. Prior to Bidding, the Contractor shall visit and examine the site verifying all existing items and familiarize himself with existing work conditions and understand the conditions which affect performance of the work of this Division before submitting bids for this work. The submission of bids shall be deemed as evidence of such visits and examinations.
- B. All bids shall take the existing conditions into consideration and the lack of specific information on the drawings shall not relieve the Contractor of any responsibility. No subsequent allowance for time or money will be allowed for work or change related to failure to examine site conditions.

1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. All work covered by this section of these specifications shall be accomplished in accordance with the respective drawings, information or instructions to bidders, and general provisions of these specifications. Any supplementary conditions, special conditions, addenda, or directives which may be issued by the Owner's representative, herewith or otherwise, shall be complied with in every respect.
- B. Provide electrical connections and service to items described in all other sections of these specifications.
- C. The Electrical Contractor shall provide all wiring and connections required to fire/smoke dampers. Coordinate exact locations of dampers with Mechanical Contractor and relay requirements with Fire Alarm Contractor.
- D. The Electrical Contractor shall provide all wiring and connections required to backdraft dampers at exhaust fans. Coordinate exact locations of dampers with Mechanical Contractor.
- E. Electrical Contractor to provide conduit and junction boxes for all sensors and exterior conduit for controls to mechanical equipment. Conduit for space sensor to extend from junction box to above accessible ceiling. Conduit for exterior equipment to extend from equipment through wall or roof to above an accessible ceiling. Any control wiring in exposed ceiling areas to be in conduit by Controls Contractor for protection. Controls Contractor to coordinate on all conduit requirements. Coordinate locations with Electrical Contractor.

1.04 WORK NOT INCLUDED

- A. Certain labor, materials, or equipment may be provided under other sections of these specifications, by utility companies, or by the Owner. When such is the case, the extent, source and description of these items will be as indicated on the Drawings or described in the specifications, but the Contractor is responsible for verifying with all parties involved as to the extent of his requirements of work.
- B. Unless otherwise indicated, motors shall be furnished by others, but connected by the Electrical Contractor as indicated on the Drawings.
- C. Unless otherwise specified, Mechanical equipment control low voltage wiring (less than 50 VAC) shall be provided and installed by the Mechanical Contractor.

1.05 SPECIFICATION TERMINOLOGY (Definitions)

- A. "Provide": Includes all material, installation, labor subcontracts, appurtenances and mark-up required for a complete operable system as shown and specified, set in place, connected and ready to use.
- B. "Furnish": Purchase and deliver to job site, material as shown and specified.
- C. "Install": Includes all installation, labor subcontracts, appurtenances and mark-up required for complete installation of equipment furnished by others.
- D. **"Record Drawings": Drawings that reflect the electrical systems as actually constructed by the Contractor including conduit routing.**
- E. "Accessible" means arranged so that an appropriately dressed maintenance man may approach the area in question with tools and products necessary for the work intended and may then position himself to properly perform the task to be accomplished, without disassembly or damage to the surrounding installation. All clearances per NEC.
- F. Wherever the term "shown on drawings" is used in the specifications, it shall mean "noted", "indicated", "scheduled", "detailed", or any other diagrammatic or written reference made on the drawings.
- G. "Conduit" includes, in addition to conduit, all fittings, hangers and other accessories relative to such conduit system.
- H. "Concealed" means hidden from sight in chases, furred spaces, shafts, hung ceilings, imbedded in construction, crawl spaces, etc.

1.06 DIAGRAMMATIC DRAWINGS:

- A. The drawings are in general diagrammatic, and the location of outlets, switches, motors, etc., on the drawings does not necessarily mean that such units shall be placed at that exact spot, as scaled on the drawings, but shall be located to function best. Use the drawings, and these specifications for guidance and secure the Engineer's approval of all changes in location. Coordinate all dimensions for floor boxes with Architect. Contractor shall not scale from drawings.
- B. Verify all measurements at the site. No extra compensation will be allowed because of differences between locations shown on the drawings and measurements at the building.

- C. The Contractor is to draw electrical rooms and service to scale **(1/4" minimum)** with actual equipment to be used and submit to the Engineer prior to installation. The Contractor must ensure that all minimum NEC working clearances are maintained. Coordinate with equipment of other trades.
- D. Where lighting fixtures and other electrical items are shown in conflict with structural members and mechanical or other equipment, provide all required supports and wiring to clear the encroachment.
- E. The branch circuits and arrangement of home runs have been designed to compensate for voltage drop and other considerations to accomplish maximum economy. Re-circuiting will not be permitted without specific approval. **Circuit numbers may change to achieve balanced loads on panels.**
- F. In the event of discrepancy, immediately notify the Engineer. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
- G. Drawings and specifications are complimentary each to the other. What is called for by one shall be as binding as if called for by both.
- H. Should the drawings disagree in themselves, or with the specifications, the better quality or greater quantity of work or materials shall be used.
- I. Outlets and switches obviously placed in a location not suitable to the finished room or area shall be removed and relocated when so directed by the Architect at no cost to the Owner. The Architect shall have the right to make any reasonable change in outlet locations before rough-in without additional cost to the Owner. The contractor shall contact engineer when switches are inadvertently shown on hinge side of door prior to rough-in.
- J. Location of light fixtures shall be coordinated with reflected ceiling plans and/or room finish schedules.

1.07 MATERIAL AND EQUIPMENT SUBMITTALS

- A. Submittals: Provide submittals for all products and systems described in Division 26-28 and shown on the drawings to demonstrate compliance with the requirements of the project. Furnish equipment submittals in the manner described elsewhere in these specifications.
- B. Submit to the Engineer, after the award of the contract or as dictated by project schedule, a type written list of those items of equipment and appurtenances which will be furnished. Include the name or description of the item, name of manufacturer, model or type, catalog number and manufacturer's printed information. The information submitted shall include overall dimensions, weights, voltage rating, phase, wiring diagrams, etc., and nameplate data. Assemble cut sheets into separate submittals as defined in this section or by Specification Section. Submit priority items and long lead time first. Then follow with remaining items. This will allow for faster review and response to accommodate project schedule. **Any submittal with all sections under one (1) submittal number will be returned and required to be broken into unique separate submittal numbers.** The Engineer's check will be general and does not relieve the Contractor of final responsibility to comply with the Contract Documents in all respects.
- C. Submittal Review Time – In order to provide the most efficient submittal review and to cut down delays of equipment with long lead times, the Engineer requests the Contractor Provide a Submittal Schedule at the beginning of the job. At the beginning of the project the contractor is to review job schedule and material lead times. Based on that information the Contractor shall put together a reasonable schedule of dates that each submittal is needed to be returned in order of importance, to order materials. ALL submittals, with separate covers and identifiers shall be submitted to the

design team as early in the projects as possible. The design team can NOT practically review ALL submittals at once in 2 weeks, but the design team can schedule review time for all submittals in priority order, based on the Contractor provided Submittal Schedule, to be returned to contractor prior to the requested schedule date from the contractor. Submittals that are haphazardly submitted late in the project cycle creating artificial time emergencies are not the responsibility of the Engineer to provide unreasonable expedited review. Complicated submittals require extended review time, and this should be taken into account. Submittal review time requested only applies to standard workdays, and excludes weekends and holidays. Extended company holidays are typical at Thanksgiving Wednesday-Friday and the final 2 weeks of the year at Christmas and New Year, our office is closed. These times frames should be considered while producing the required Submittal Schedule.

- D. Submittal review is for general design and arrangement only and does not relieve the Contractor from any of the requirements of the Contract Documents. Submittals will not be checked for quantity, dimension, fit or proper technical design of manufactured equipment. Where deviations of substitute product or system performance have not been specifically noted in the submittal by the Contractor, provision of a complete and satisfactory working installation is the sole responsibility of the Contractor. **Warranties cannot be reduced through the submittal process.**
- E. **Contractor shall indicate items being used on cut sheets by highlighting or arrowing to actual part number. Submittals may be returned without checking if submittals not appropriately marked.**
- F. **'Individual submittals' means separate submittals with unique submittal numbers for each specification section. Separate PDFs for each Submittal number.**
- G. **HARDCOPY SUBMITTAL REQUIREMENT: Hardcopy submittals will not be required by Engineer.**
- H. **PDF SUBMITTAL REQUIREMENT:**

For submittal sections listed below as allowed pdfs, the following requirements must be met, or the submittal will not get through email security and will be auto-deleted and not checked. Each specifications section must be a separate pdf file, **one giant pdf for all sections will be rejected.**

PDF FILE: MUST BE NAMED AS FOLLOWS:

JOB NAME – SUBMITTAL No. XX – SUBMITTAL DESCRIPTION

EMAIL TITLE/SUBJECT: FOR SUBMITTALS MUST BE AS FOLLOWS:

JOB NAME – SUBMITTAL No. XX – SUBMITTAL DESCRIPTION

Failure to follow these instructions will result in the submittal never reaching the engineer and not being checked. Delays caused by not following these procedures are the sole responsibility of the contractor. Emailed submittals must come from the Architect and must not be emailed directly from the contractor. Do not Carbon Copy the Engineer on Emailed submittals.

- I. **Multiple re-reviews required due to Contractor not following instructions, specifications, etc. will be billed to Contractor at Engineer's current hourly rates. This shall be paid prior to submittal approval.**
- J. **Submittals will be returned in order of construction of the project, not necessarily in order submitted.** If all sections are submitted under one binder/at one time and transmittal, each section will be returned at the appropriate time for construction phasing. Electrical Gear will not be reviewed until "Mechanical/Electrical Coordination Sheet" has been submitted. Electrical Gear and Light Fixtures may require extended review time. **If submittals are submitted early relative to**

construction phasing, submittals may be held, reviewed and returned at the appropriate time for construction phasing, not necessarily 2 weeks. In some cases, if submittals are received vastly out of order of construction, submittal may be rejected.

K. **DO NOT submit the following sections unless deviating from the schedules/specifications. Provide directly to General Contractor/CMR for inclusion into O & M Manuals. If deviating from the specifications, submittal will be required. (Deviations must be noted on Transmittal and Highlight items in each submittal content that are different to allow for proper review.)**:

1. 26 05 00 – General Provisions
2. 26 05 10 – Schedule of Values
3. 26 05 19 – Wire and Cable
4. 26 05 26 – Grounding and Bonding
5. 26 05 29 – Hangers and Supporting Devices
6. 26 05 33 – Raceways
7. 26 05 34 – Outlet Boxes, Pull Boxes and Junction Boxes
8. 26 05 80 – Empty Raceway Rough-In
9. 26 27 26 – Devices
10. 26 28 10 – Manual Motor Starters
11. 26 28 15 – Safety Disconnect Switch
12. 26 28 16 – Fuses
13. 26 28 20 – Combination Motor Starters
14. 26 28 25 – Contactors

L. **PDF Submittals Allowed for Product Cut-Sheets are limited to the following items: Separate PDF file for each Submittal number is required. Follow file format above.**

1. 26 05 00 - Mechanical/Electrical Coordination Sheet
2. 26 05 00 - Plumbing/Electrical Coordination Sheet
3. 26 24 16 – Branch Circuit Panelboards
4. 26 51 00 – Interior Lighting System
5. 26 56 00 – Exterior Lighting System
6. 26 43 00 – Surge Protective Devices
7. 28 46 00 – Fire Alarm System - (Product Data and Shop Drawings)
8. Electric Rooms (coordinate with mechanical). Also, include other equipment and/or systems on plan.

M. When requested, present samples of all materials proposed for use to the Engineer for his approval.

N. Certify Shop Drawings have been checked for compliance with Contract Documents. Certify that the materials submitted can be delivered and installed according to the construction schedule.

- O. Select all other materials, not specifically described on the Drawings or in these specifications but required for a complete and operable facility and submit to the Engineer for approval.
- P. **Substitutions:** ("Substitution Request" form must be submitted)
1. Substitutions must be made and accepted PRIOR to Bid.
 2. Unless otherwise indicated, base bid on the equipment shown on the Drawings and hereinafter specified.
 3. Request for approval to substitute materials, methods, or processes shall be made to Architect and if found acceptable, will be confirmed by an addendum to the Construction Documents. Where proposed substitutions are not incorporated into the Construction Documents by addendum **PRIOR** to time of the General Contract bid opening, all bids shall be held to have been made on the basis of the materials, methods and processes required by the Construction Documents.
 4. All substitutions shall be of equal or better quality to the equipment specified.
 5. Acceptance of the substitution by the Engineer does not relieve the Contractor of responsibility for proper operation of the systems, compliance with specifications, necessary changes due to dimensional differences or space requirements, and completion of work on schedule.
 6. It is not the intent of the Specifications to limit materials to the product of any particular manufacturer. Where definite materials, equipment and/or fixtures have been specified by name, manufacturer, or catalog number, it has been done so as to set a definite standard and a reference for comparison as to quality, application, physical conformity and other characteristics unless no substitutions are noted.
 7. **Submit fully completed "Substitution Request" form located at end of this section. If this form is not submitted, all substitution requests will be automatically rejected.**
 8. **For substitutions that require substantial review by engineer to ensure equality, the contractor requesting substitutions shall reimburse the engineer at current hourly rates for all review time. This shall be paid prior to submittal approval. This applies to all equipment not previously approved on construction documents.**
 - a. Light Fixtures Packages
 - b. Alternate Transformers
 - c. Alternate Surge Protective Devices
 - d. Alternate Equipment/Gear Packages
 - e. Contractor Cost Savings Packages Requiring Substantial Review Time

1.08 SHOP DRAWINGS REQUIRED

- A. Prepare and submit working construction drawings as requested, specified, and otherwise necessary to demonstrate proper planning for installation and arrangement of all work. Layout drawings to scale and show dimensions where accuracy of location is necessary for coordination or communication purposes. Show work of all trades, including Architectural, Structural, Mechanical, and Electrical items which may be pertinent to proper and accurate coordination.

- B. Architectural drawings must be used for backgrounds in preparation of shop drawings and shall be obtained from the Architect. Confirm requirements and stipulations for obtaining floor plan backgrounds with Architect and with other sections of specification. Engineer's drawings and CAD files **may not** be used for Shop Drawings. Reference 1.01-L.
- C. Reference other specification for additional requirements.
 - 1. Fire Alarm
 - 2. PA System
 - 3. Electrical Rooms

1.09 RECORD DRAWINGS

- A. Reference requirements stated elsewhere in the specifications.
- B. THE CONTRACTOR SHALL TAPE ALL ADDENDAS ISSUED DURING BIDDING TO HIS CONSTRUCTION AND RECORD DRAWING SET PRIOR TO COMMENCING CONSTRUCTION. PAY REQUESTS WILL NOT BE PROCESSED UNTIL THIS REQUIREMENT IS MET.
- C. In addition to other requirements, a master Record Drawing print set (separate from field sets) shall be kept in the site construction office as the work progresses. Show routing and location of items cast in concrete or buried underground. Work located in spaces with access, or above suspended ceilings, is not considered permanently concealed. Show complete routing and sizing of any significant revisions to the systems shown. Indicate locations of all existing active and inactive conduit uncovered during construction. **Keep marked up set at site for review at site meetings.**
- D. **Contractor to indicate conduit routing locations for all major runs and branch circuits under slab along with major junction locations.**
- E. The Contractor shall be responsible for updating all items, including but not limited to floor plan changes, system changes, addendums, change orders, etc. on the prints to "As-Built" conditions. At the completion of the job the marked up As-Built Drawings shall be submitted to the Architect for final review and comment. These corrected prints together with all the revisions, additions, and deletions of work, shall form the basis for preparing a set of record drawings.
- F. Using the "Record Drawing Set", the Contractor shall print two (2) complete sets of prints, one for submission to the Owner and one rolled in a 4" PVC pipe in main electric room mounted to wall and labeled. Tape all edges. The contractor shall provide pdf copies/scans for owner record purposes. Remove Engineer's seal from record drawings.
- G. The Contractor shall bear all the costs of producing the "Record Drawing Set".
- H. Electrical riser diagrams shall be laminated and mounted in the main electrical room or as directed by the Engineer.

1.10 CODES, REGULATIONS AND ORDINANCES

- A. Comply with the requirements of the National Electrical Code, National Electrical Safety Code, Occupational Safety and Health Act (OSHA) and all other applicable Federal, State, and local codes and ordinances. All codes and standards shall be per the latest adopted edition with all supplements and official interpretations included. Provide disconnecting means for all equipment per NEC. The Drawings and specifications take precedence when they are more stringent than codes, standards, ordinances, and statutes take precedence when they are more stringent or conflict with the Drawings and specifications.

- B. Should the Contractor perform any work that does not comply with the requirements of the applicable Building Codes, State Laws, Local Ordinances, and Industry Standards, he shall bear all costs arising in correcting the deficiencies, as approved by the Architect.
- C. All work shall also satisfy applicable local codes, ordinances, and regulations of the governing bodies, and all authorities having jurisdiction over the work. Where alterations to, or deviations from, the drawings and specifications are required by the authority having jurisdiction, report the same in writing to the Owner's representative and secure his approval before proceeding.

1.11 DELIVERY AND STORAGE OF EQUIPMENT AND MATERIAL

- A. Investigate each space in the building through which equipment must pass to reach its final location. If necessary, the manufacturer shall be required to ship his material in sections sized to permit passing through such restricted areas in the building.
- B. Retain all portable and detachable parts or portions of installation such as fuses, key locks, adapters, blocking clips, and inserts until final completion of work. Deliver parts to the Owner or his authorized representative and attach an itemized receipt to obtain request for final payment.
- C. Product Handling:
 - 1. Use all means necessary to protect the work and materials of this section before, during, and after installation and to protect the work and materials of all other trades.
 - 2. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Engineer and at no additional cost to the Owner.
 - 3. Store and protect materials and equipment in accordance with the manufacturer's recommendations.
 - 4. Provide suitable box or crate electrical equipment and cover with waterproof covers to protect against dirt, moisture, or accidental damage during shipment or outdoors at the job site.
 - 5. Store all conduits on skids.

1.12 SERVICEABILITY OF PRODUCTS

- A. Furnish all products to provide the proper orientation of serviceable components to access space provided.
- B. Coordinate installation of piping, ductwork, equipment, conduits, junction boxes, panels, and other products to allow proper service of all items requiring periodic maintenance or replacement.
- C. Replace or relocate all products incorrectly ordered or installed to provide proper serviceability.

1.13 ACCESSIBILITY OF PRODUCTS

- A. Arrange all work to provide permanent, convenient, and safe access to all serviceable and/or operable products. Layout work to optimize net usable access space within confines of space available. Advise Architect, in a timely manner, of areas where proper access cannot be maintained. Furnish layout drawings to verify this claim, if requested.

- B. Provide access doors in ceilings, walls, floors, etc. for access to automatic devices and all serviceable or operable equipment in concealed spaces. Location of panels shall be submitted for approval in sufficient time to be installed in the normal course of work.

1.14 UTILITY COSTS

- A. Provide complete utility service connections. The locations and elevations of the various utilities included within the scope of this work have been obtained from city and/or other substantially reliable sources as a general guide only, without guarantee as to accuracy. Verify the locations, elevations, and availability of all utilities and services required, and be adequately informed as to their relation to the work.
- B. Include all service charges required by the electric utility or telephone/data/cable utility. Reference General Conditions for further information. Keep all utility company charges as a separate line item in bid. If cost is not available from utility company, indicate utility contact person, telephone number and **date of contact**.

1.15 CLEAN-UP

- A. Remove debris and waste materials from within the construction areas and transport off-site, daily.
- B. Keep the construction area clean, free from hazard, and orderly arranged.
- C. Pay all costs of waste removal and disposal. Reference General Conditions for further information.
- D. Dispose of waste materials in accordance with all regulations which govern.
- E. Take all precautions to protect persons who enter the construction area from hazardous conditions, hazardous waste, toxic waste, or other unsafe conditions.
- F. Upon completion of construction, remove all debris, waste materials, unused materials, temporary constructions, vehicles, tools, fencing, etc. to Owner's satisfaction.
- G. All equipment and materials shall be protected from physical moisture absorption, metallic corrosion, and weather damage from time of delivery to completion of project. Replace any damaged materials.

PART 2 - PRODUCTS

2.01 EQUIPMENT AND MATERIALS

- A. Unless otherwise indicated, provide only new equipment and materials.
- B. On all major equipment components, provide manufacturer's name, address, model number, and serial number permanently attached in a conspicuous location.
- C. All materials furnished under these specifications shall be the standard product of manufacturers regularly engaged in the production of such equipment and shall be the manufacturer's latest approved standard design.
- D. Guarantees:
 - 1. The Contractor and Manufacturers shall provide a ONE (1) YEAR guarantee for all work under the Electrical Trade. However, such guarantees shall be in addition to and not in

lieu of all other liabilities which the manufacturer and the Contractor may have by law or by other provisions of the Contract Documents. In any case, such guarantees and warranties shall commence when the Owner accepts the mechanical/electrical system, as determined by the Architect, and shall remain in effect for a period of ONE (1) YEAR thereafter.

2. All materials, items of equipment, all lighting, and workmanship furnished under each section shall carry a ONE (1) YEAR warranty against all defects in material and workmanship. Any fault under any contract, due to defective or improper material, equipment, workmanship, or design which may develop, shall be made good, forthwith, by and at the expense of the Contractor for the work under his Contract, including all other damage done to areas, materials and other systems resulting from this failure.
 3. The Contractor shall guarantee that all elements of the system, which are to be provided under his Contract, are of sufficient capacity to meet the specified performance requirements as set forth herein or as indicated.
 4. Upon receipt of notice from the Owner of failure of any part of any systems or equipment during the guarantee period, the affected part or parts shall be replaced by the Contractor for his respective work, as applicable.
 5. Furnish, before the final payment is made, a written guarantee covering the above requirements.
 6. Reference other guarantee information elsewhere in these specifications.
- E. All materials exposed within a plenum shall be noncombustible or shall have a flame spread index of not more than 25, and a smoke developed index of not more than 50, when tested in accordance with ASTM E 84.

2.02 STANDARDS

- A. Where the Underwriters' Laboratories (UL) have established standards and issued labels for a particular group, class or type of material, apparatus, appliance, or device, provide the UL label on all such items in that category incorporated into the work.
- B. Where such items are not covered by UL standards, they shall meet or exceed the requirements of the current National Electrical Code (NEC), or if not covered there, by the applicable, published, recognized standard of the American National Standards Institute (ANSI), or of the industry and of the related engineering society. Example: National Electrical Manufacturers Association (NEMA) and Institute of Electrical and Electronics Engineers (IEEE).
- C. Contractor is to follow the most current version adopted for all codes and standards.

PART 3 - EXECUTION

3.01 CUTTING AND PATCHING

- A. Carefully lay out all work in advance so as to minimize cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, etc. Perform all cutting, channeling, drilling, etc., as required for the proper support, concealment, installation, or anchorage of raceways, outlets, or electrical equipment in a careful manner. Any damage to the building, structure, piping, ducts, equipment, or defaced finish, tile, plaster, woodwork, or metal work shall be repaired by skilled mechanics of the trades involved at the Contractor's expense and to the satisfaction of the Engineer. All cutting, channeling, chasing, or drilling of unfinished masonry, tile, etc., or cutting, drilling, anchoring to or

welding of structural members shall be performed in a manner having the Engineer's prior approval. All openings made in fire rated or smoke rated walls, floors, and ceilings shall be patched and made tight in a manner to conform to the fire rating or smoke rating for the enclosure.

- B. Where conduits pass through exterior walls, thoroughly caulk with sealant the annular space around the conduit to provide a watertight closure at the interior wall cavity and exterior wall surface. Provide $\frac{1}{4}$ " maximum annular space around the conduit. Provide and install all counterflashing of all conduit, pipe and supports which pierces roofs and other weather barrier surfaces. Verify detail with Architect before installation. All work shall be performed in a workmanlike manner to assure weatherproof installation. Any leaks developed shall be repaired at his expense, to Architect's satisfaction. All waterproofing, flashing and counterflashing shall be compatible with roofing system so as not to void any roof warranties. Confirm installation with Architect and Roofing Contractor.

3.02 SEALING AND FIREPROOFING

- A. SEALING OF PENETRATIONS THROUGH RATED WALLS, FLOORS, CEILING AND ROOF ASSEMBLIES SHALL BE INSTALLED PER UL "FIRE RESISTANCE DIRECTORY." UL SYSTEM NUMBERS INDICATED ARE FOR A PARTICULAR LISTED INSTALLATION AND ARE FOR GENERAL INFORMATION AND INTENT. OTHER LISTED UL SYSTEM DESIGNS MAY BE USED. IN ALL CASES, SUBMIT MATERIALS, UL SYSTEM DESIGN NUMBERS AND UL DETAILS TO BE USED THROUGHOUT THE PROJECT AND IDENTIFY WHICH DETAIL IS TO BE USED FOR EACH SPECIFIC CONDITION. POST REVIEWED DETAIL AT JOB SITE FOR REFERENCE.

1. Only materials tested in the specific UL System No. may be used.
 - a. Caulk Manufacturer:
 - 1) 3M Type CP-25 W/B + for all assemblies requiring 3M caulk.
 - 2) For WL3045 and WL3046 use Hilti FS611A sealant.
 - b. Steel Sleeve (stud wall) (UL System No. WL1003): Cylindrical sleeve shall be fabricated from minimum 0.019" thick (no. 28 gauge) galvanized sheet steel and having a minimum two-inch (2") lap along the longitudinal seam. Length of steel sleeve to be equal to thickness of wall plus one inch (1") such that, when installed, the ends of the sleeve will project approximately $\frac{1}{2}$ " beyond the surface of the wall on both sides of the wall assembly. The diameter of the openings cut on each side of the wall assembly (concentric with conduit) to be 2 to 2- $\frac{1}{2}$ " larger than the outside diameter of conduit such that, when the steel sleeve is installed, a 1 to 1- $\frac{1}{4}$ " annular space will be present between the steel sleeve and the conduit around the entire circumference of the conduit. Install sleeve by coiling the sheet steel to a diameter smaller than the through opening, inserting the coil through the openings and releasing the coil to let it uncoil against the circular cutouts in the gypsum wallboard layers.
 - c. Optional Steel Sleeve (concrete or block wall): Except for single insulated cables, provide sleeve cast in floor/wall or mortared into CMU wall; Schedule 40 or heavier, length to extend a maximum one inch (1") from top surface of floor or a maximum of one inch (1") from both sides of wall.
 - d. Forming Material: Minimum one-inch (1") thickness mineral-wool batt insulation material. Tightly pack into sleeve with minimum $\frac{1}{2}$ " recess on ends. Manufacturer: Thermafiber Safing Insulation.

2. Firestop system shall be installed at top surface of floor and symmetrically on both sides of wall assemblies and one (1) side of floor.
 3. Alternate floor penetration system (with firestop mortar): UL System No. CAJ1032.
 4. Wires and Cables:
 - a. For gypsum frame wall, single cable: Fireproof per UL System No. WL3001. Opening for cables to be hole-sawed through gypsum wall board layers. Diameter of opening to be 3/8" to 5/8" larger than outside diameter of cable. Cable to be rigidly supported on both sides of wall assembly. Caulk to fill annular space throughout thickness of gypsum wall board layers and apply 1/4" bead of caulk to perimeter of cable at its egress from wall (both sides).
 - b. For gypsum frame wall, multiple cables: Use UL system No. WL3021, WL3045, WL3046 or equivalent to maintain rating of wall.
 - c. For concrete walls/floors or CMU walls, single or multiple cables: Fireproof per UL System No. CAJ3030. Install sleeve in assembly flush with both sides. Cables to be a minimum of ten percent (10%) and a maximum of thirty-three percent (33%) of cross-sectional area of opening. Recess minimum one inch (1") thickness of mineral wool material into opening around cables. Caulk openings around cable to minimum depth of one inch (1"). Optional sleeve may be used per UL detail requirements.
 5. Reference Architectural for the exact location of all rated walls, floors, ceilings, and ceiling/roof assemblies.
 6. Materials used in firestop systems shall be installed in accordance with the manufacturer's written instructions (shall be posted at job site, in General Contractors trailer), provided with materials for specific UL System No.
 7. Manufacturers: 3M, Metacaulk, Hilti, BioFireShield or equal.
- B. In non-rated walls identified for sound insulation, provide 1/2" space between conduit and sleeve packed with multiple layers of forming material. Allow 5/8" minimum space on each side and caulk with acoustical sealant.
- C. **Final condition to prevent passage of fire, smoke, noxious gas, and water.**
- D. For non-rated electrical/mechanical rooms: Seal all conduit passing through room walls, floors and ceilings with 3M caulk, Type CP-25 WB+.

3.03 WORKMANSHIP AND COMPLETION OF INSTALLATION

- A. For the actual fabrication, installation, and testing, use only thoroughly trained and experienced workmen completely familiar with the items required and with the manufacturer's recommended methods of installation. In acceptance or rejection of the installed work, no allowance will be made for lack of skill on the part of workmen.
- B. Install all specialties as detailed on plans. Where details or specific installation specifications are not included herein, follow approved manufacturer's recommendations.
- C. Install complete, thoroughly check, correctly adjust, clean, and leave ready for operation all equipment and material connected with this project.

- D. Ballasts, contactors, starters, transformers and like equipment which are found to be noticeably noisier than other similar equipment on the project will be deemed defective and shall be replaced.
- E. Electrical service stub locations, sizes and quantities for equipment are approximate only. The Contractor must verify all service locations, sizes and quantities with the equipment supplier before rough-in.
- F. The Electrical Contractor shall make all final connections to all electrical equipment furnished and set in place by others, including millwork with outlets. The Electrical Contractor shall provide and install all disconnect switches as required.
- G. The Electrical Contractor shall provide/install all circuit breakers, power wiring, conduit systems and final connections required for operation of heating cable systems.
- H. Provide and install all adjustable mounting brackets, steel bar hangers, T-bar mounting clips, support channels and universal support bridges as required for installation of recessed light fixtures, speakers, alarm devices and other ceiling mounted devices. Ceiling tile shall not be used to support ceiling mounted devices in lay-in ceilings.
- I. Provide wood trim for any semi-recessed panels installed. Verify finishes with the Owner/Architect.
- J. Provide Hoffman enclosure (#A-244208WFLP) wall mounted at location shown on plans. Provided in enclosure shall be spare fuses, three (3) of each amperage used in project up to 100-amp size and spare smoke detectors (see Section 28 46 00.)
- K. Equipment and materials shall be listed by an organization that evaluates products and states that the equipment or material, either meets appropriate designated standards or has been tested and found suitable for a specified purpose or shall be labeled by the manufacturer to indicate compliance with appropriate standards or performance in the specified manner to be used.
 - 1. Listed or labeled equipment and materials shall be applied, installed, connected, erected, used, cleaned, adjusted, and conditioned in accordance with any instructions included in the listing or labeling.
- L. The installation shall be performed by licensed, competent workmen to provide a thorough and complete installation.
- M. All work shall be accomplished in conjunction with other trades in a manner which will allow each trade adequate time at the proper stage of construction to fulfill his work.
- N. Exact locations shall be determined by reference to the general plans and measurements at the building and shall be subject to reasonable change by the Owner's representative without additional cost.
- O. Prior to and during construction, provide adequate storage facilities and properly protect items subject to any damage. Failure to comply with this provision will be sufficient cause for the rejection of the particular apparatus involved.
- P. At completion, the installation shall be thoroughly cleaned. All tools, equipment, obstructions, temporary power, temporary lighting, and debris shall be removed from the premises.

3.04 BALANCING SYSTEM

- A. Balance the electrical system between the respective phases of the system. Balance individual circuits in each panel of the system. Where phase assignments or circuit numbers are indicated on the drawing, do not deviate without the Engineer's approval. All deviations shall be noted on panelboard submittals and on Record Drawings and schedules.

3.05 COOPERATION WITH OTHER CONTRACTORS

- A. Cooperate with other Contractors so that the installation of the electrical materials and equipment may be properly coordinated. Where a conflict occurs with piping, duct work, etc., it shall be resolved as directed by the Engineer.
- B. Interferences between conduit and other trades shall be handled by giving precedence to pipelines requiring grade for proper operation. Where space requirements conflict, the following order of precedence shall generally be observed:
 - 1. Building Lines
 - 2. Structural Members
 - 3. Drainage Waste and Vent Piping
 - 4. Refrigerant Piping
 - 5. Ductwork
 - 6. Water and Gas Piping
 - 7. Electrical Conduit
 - 8. Fire Protection Piping

3.06 COORDINATION OF WORK

- A. Each Contractor shall compare his drawings and specifications with those of other Trades and report any discrepancies between them to the Architect and obtain from the Architect written instructions to make the necessary changes in any of the affected work. All work shall be installed in cooperation with other Trades installing inter-related work. Before installation, all Trades shall make proper provisions to avoid interferences in a manner approved by the Architect.
- B. Locations of conduit and equipment shall be adjusted to accommodate the work with interferences anticipated and encountered. Exact routing and location of systems shall be determined prior to fabrication or installation.
- C. Offsets and changes of direction in all conduit systems shall be made as required to maintain proper headroom and pitch of sloping lines whether or not indicated on the drawings.
- D. Where discrepancies in scope of work as to which Trade provides items such as starters, disconnects, flow switches and the like exist, such conflicts shall be reported to the Architect prior to signing of the Contract. If such action is not taken, the various Trades shall furnish such items as part of their work for complete and operable systems.

- E. Verify voltage, phases, termination points, termination requirements and required disconnects for all equipment provided as part of this contract or equipment furnished by Owner prior to rough-in. Report any discrepancies to Architect/Engineer.
- F. The Contractors are to avoid routing conduit through fire rated assemblies where practical. Each trade is responsible for proper coordination of required sleeves or block-outs with rated assembly installers. Each trade is responsible for providing sleeves, as required, for his work. Each trade shall verify acceptable tolerances around penetrating item in fire assembly before beginning fire sealing.
- G. **The Electrical Subcontractor shall verify with HVAC, Plumbing and Fire Protection Subcontractors the required electrical characteristics for all motors and equipment before ordering and submitting of electrical gear. Verify actual connection points prior to installation and roughing-in. Mechanical and Electrical Contractor are responsible for coordination of electrical requirements and final fuse sizes of all A/C equipment. When Mechanical Contractor substitutes equipment that requires additions or upgrades to electrical system, he shall bear all costs arising from such substitutions. Reference "Mechanical/Electrical Coordination Sheet" in specifications.**

3.07 SAFETY PRECAUTIONS AND PROGRAMS

- A. It shall be the duty and responsibility of the Contractor and all of its subcontractors to be familiar and comply with all requirements of Public Law 91-696, 29 U.S.C. Secs. 651 et. seq., the Occupational Safety and Health Act of 1970, (OSHA) and all amendments thereto, and to enforce and comply with all of the provisions of this Act. IN ADDITION, ON PROJECTS IN WHICH TRENCH EXCAVATION WILL EXCEED A DEPTH OF FIVE FEET, THE CONTRACTOR AND ALL OF ITS SUBCONTRACTORS SHALL COMPLY WITH ALL REQUIREMENTS OF 29 C.F.R. SECS. 1926.652 AND 1926.653, OSHA SAFETY AND HEALTH STANDARDS.

3.08 OPERATING AND MAINTENANCE MANUALS

- A. Provide one (1) Operation and Maintenance manual for training of Owner's personnel in operation and maintenance of systems and related equipment in the manner described elsewhere in these specifications. In addition, organize manuals and include data and narrative as noted below (bind each manual in a hard-backed loose-leaf binder. Use 8-1/2" x 11" white paper). Provide PDF copy of O&M for owner records.
- B. Operating Sequence and Procedures:
 - 1. Contents: In each chapter, describe the procedures necessary for personnel to operate the system and equipment covered in that chapter.
 - 2. Typewritten Operating Procedures: Write procedures for start-up, operation, and shutdown.
 - a. Start-up: Give complete step-by-step instructions for energizing equipment, making initial setting and adjustments whenever applicable.
 - 3. Shutdown Procedures: Include instructions for stopping and securing the equipment after operation. If a particular sequence is required, give step-by-step instructions in that order.
- C. Maintenance Instructions:
 - 1. Provide a schedule of preventive maintenance for each product. Recommend frequency of performance for each preventive maintenance task: i.e., cleaning, inspection, etc.

- D. Manufacturer's Brochures: Include manufacturers' descriptive literature covering all appurtenances used in each system, together with illustrations, exploded views and renewal parts lists. Provide the nearest manufacturer's representative's name, address and phone number.
- E. Shop Drawings: Provide two copies of all corrected, approved submittals and shop drawings covering equipment for the project either with the manufacturer's brochures or properly identified in a separate subsection.
- F. Spare Parts Lists: Include a list of all equipment furnished for the project, with a tabulation of descriptive data of all the spare parts proposed for each type of equipment or systems. Properly identify each part-by-part number and manufacturer.
- G. Lighting Controls Factory Start Up Report shall be included in O & M Manuals.

3.09 IDENTIFICATION

- A. Equip the following items with nameplates:
 - 1. Motor Starters
 - 2. Main Switchboard and Overcurrent Devices and Spares
 - 3. Panelboards and Branch Circuits
 - 4. Safety Disconnect Switches
 - 5. Contactors
 - 6. Control/Power Equipment in Separate Enclosures Including Relays
 - 7. Bypass Switches and Transfer Switches
 - 8. Emergency Generator Sets
 - 9. UPS System and Battery Racks
 - 10. Motor Control Centers
 - 11. Transformers
- B. No dymo (stick on indented plastic) type label will be permitted.
- C. Identify equipment listed above. COORDINATE EQUIPMENT NUMBERS WITH MECHANICAL AND/OR KITCHEN PLANS. Each piece of equipment shall be numbered consistently throughout.
- D. Fabricate nameplates as follows:
 - 1. Provide three (3) ply, 1/16" laminated plastic nameplate material with white core for lettering and black background. All nameplates, for equipment powered from emergency circuits, shall have white core for lettering and red background.
 - 2. Use capital letters.
 - 3. Unless otherwise indicated, provide minimum 3/4" high x 2" long nameplates with 1/4" letters.

- 4. All labels shall be permanently affixed to the front of all required equipment using two (2) round head self-tapping screws. Self-adhesive labels are not acceptable. Align labels with equipment.
- E. All junction boxes shall have the panel/circuit number(s) identified on the blank coverplate, handwritten with a permanent black marker. Disconnects, combination motor starter/disconnects, and manual motor starter shall have the panel/circuit number(s) identified on the inside of the front cover, handwritten with a permanent black marker.
- F. Provide engraved coverplates for all switches and control devices which are not otherwise clearly related to the equipment they serve.
- G. **Label all receptacles and light switches with circuit number using electronic labeler (black on clear). Install label level on front of face plate for receptacles and back side of face plate for light switches.**
- H. Spray paint J-Boxes red for Fire Alarm System. All other special systems J-Boxes to be painted white.
- I. Color code all 600 volt insulated conductors by installing conductors with factory colored insulation for conductors No. 10 AWG and smaller.
- J. Install colored tape on all 600-volt conductors No. 8 AWG and larger. Apply tape 6 inches from terminal points. Do not cover factory applied cable identification markings with taping; tape locations may be adjusted slightly to prevent the covering of factory markings. Tape shall be Scotch No. 35 or approved equal, 7-mil thick by 3/4" wide vinyl adhesive tape.
- K. Install engraved plastic laminate nameplates as listed below.

EQUIPMENT	LETTERING SIZE	INFORMATION
Switchboards, Panelboards, MCCs and other distribution system overcurrent devices	1/4" / 1/8"	Switchboard name designation, ampere rating of the supply conductors, voltage characteristics, power source and room number(s). EX: MDP, 1900A, 480Y/277V, Served from Utility EX: HVA, 175A, 480Y/277V, source DP-1,3,5. in Room 100.
Transformers	1/4" / 1/8"	Transformer name designation, load served, power source and room number(s). EX: Trans. TR-1, serves PANEL LV-1, source DP-7,9.11 in Room 203.
Remotely mounted Safety Switches and Starters	1/8"	Load served, power source and room number(s). EX: HWP-1, HVA 37,39,4 1 in Room 203. EX: PANEL LV-2 in Room 303, source TR-2.
Contactors	1/8"	Load served, power source and room number(s). EX: Room 502, Science Lab, LVA 31,33 35, 37,39,4 1. EX: Building security lights, HVA 2, 4. EX: Parking lot lights, HVA 6, 8, 10.

- L. Prepare a neatly typed panelboard circuit directory. Identify all circuits by the equipment served and by the room number, room numbers may be different from those shown on drawings. Verify room numbers prior to typing directories. Indicate spares and spaces with light, erasable pencil marking.

3.10 TESTING

- A. Test and record results for all power feeders for Megger Readings, including phase to phase and phase to ground as recommended by the cable manufacturer.
- B. Measure and record service ground resistance.
- C. For equipment having ground-fault protection, the ground-fault protection system shall be performance tested when first installed on site. The test shall be conducted in accordance with instructions which shall be provided with the equipment. A written record of this test shall be made and shall be submitted to the Engineer and a copy put in the Operation and Maintenance Manuals.

3.11 CERTIFICATE OF COMPLETION

- A. Submit, at time of request for final inspection, a completed letter in the following format:
 - 1. I, (Name) , of (Firm) , certify that the electrical work is complete in accordance with Contract Plans and Specifications, and authorized change orders (copies attached) and will be ready for final inspection as of (Date). I further certify that the following specification requirements have been fulfilled:
 - 2. Megger readings performed, pdf copy of logs attached.
 - 3. Ground tests performed, pdf copies of method used and results attached, including service ground readings and ground fault test results.
 - 4. Operating manuals completed and instructions of operating personnel performed for all systems, (Date) , (Signature, Owner's Representative).
 - 5. Record drawings up-to-date and ready to deliver to Engineer.
 - 6. Fire alarm system final connections, check-out and start-up completed on (Date) by (Signature, Factory Authorized Representative and Trained Technician) .
 - 7. Gear Coordination Study.
 - 8. Ground Fault Settings Completed and Documented, pdf attached.
 - 9. Factory Lighting Control Start-up, Completed pdf attached.
 - 10. Factory Transformer/SPD Start-up Completed pdf attached.
 - 11. Factory Generator/ATS Start-Up Completed pdf attached
 - 12. All other tests required by Specifications have been performed.
 - 13. Final clean-up is completed.
 - 14. All systems are fully operational.

◇ Signed: _____

3.12 SITE OBSERVATION

- A. Periodically, the Engineer will visit the site and review the construction progress. Field Reports will be issued noting any discrepancies or items that do not meet the intent of the contract documents found during said site visit. The contractor must respond to each item listed on each field report in writing, item by item. Large projects may break up site walks by area, project must be 75,000 sqft or larger to request multiple site trips for same type of inspection. Minimum sqft size of divided inspection should be 30,000 sqft or larger.
- B. **Contractor Readiness Forms:** Contractors are to complete all Contractor Readiness Forms from Engineer for each phase of inspection prior to calling for any engineering site inspections. Contractor Readiness Form must be acknowledged in writing and pictures when appropriate, some are room by room, some are per each piece of equipment depending on form. These forms must be completed, signed off by installing contractor as complete and General Contractor as verified, and submitted with request for calling for site inspections. If forms are incomplete, missing name of person verifying, missing phone number of person verifying, then site visit will not be scheduled.
- C. **It shall be the duty of the Contractor to personally make a careful inspection trip of the entire project, assuring himself that the work on the project is ready for final acceptance before calling upon the Owner, Architect or Engineer to make final acceptance of the work. Subsequent trips required because of Contractor's failure to do so, will be made at Contractor's expense, billed at current Engineer's hourly rates. Minimum return site trip for final inspection due to contractor negligence and not finalizing contractor readiness form \$2,500 per trip.**
- D. The final acceptance of the work will be made jointly by the Architect and the Owner.
- E. Time spent for Investigation/Site Trips due to Contractor lack of installation capabilities/skills or knowledge is not part of Engineer's scope. Therefore, time spent assisting contractor in these matters or problems that arise due to these matters will be billed to Contractor. Engineer will bill the contractor at the current hourly rates of the Engineer. These fees will be paid in full prior to release of contingency.
- F. Contractor required to show compliance with code/Owner required commissioning scope. Reference Commissioning requirement for additional scope.
- G. Contractor to obtain a Fieldwire Pro license or other software required by Commissioning Agent for the duration of the project.

3.13 DURING FINAL INSPECTION

- A. Demonstrate installation to operate satisfactorily in accordance with requirements of Contract Documents.
- B. Should any portion of installation fail to meet requirements of Contract Documents, repair or replace items failing to meet requirements until items can be demonstrated to comply.

3.14 CLOSE-OUT DOCUMENTS:

- A. Provide PDF of information requested, in organized, bookmarked format.
- B. Furnish PDF signed letters of guarantee.
 - 1. Clearly and individually, document all material, equipment and service guarantees beyond a single year.

- C. Furnish pdf copy of a statement from the inspecting authority stating that the installation has been accepted and approved.
- D. Furnish pdf and an electronic "AutoCad" version, of complete, full-size sets of drawings showing conduit locations by accurate dimensions from permanent structures.
 - 1. **"Record Drawings"** are to include:
 - a. A sheet legend shall be present on the 1st sheet of the required set which identifies each sheet making-up the set.
 - b. Site plan(s) with primary and secondary electric power and communication lines to the property line (may be a civil sheet).
 - c. Site plan(s) with all underground conduits to other buildings, structures, fixtures, and equipment.
 - d. Marked-up electrical plans and schedules.
- E. Furnish pdf complete sets of overload settings and motor data records.
- F. Furnish pdf complete sets of the electrical testing results.
- G. Furnish pdf complete sets of the power system study final report.
- H. Furnish all manufacturer's software if required for start-up or modifying products furnished.
- I. Furnish pdf complete sets of the AC Drive's comprehensive manual that includes operation, programming, diagnostics, applications, wiring diagrams, layout diagrams, and outline dimensions.
 - 1. Identify each AC Drive's model number on a cover sheet.
- J. All major Owner training sessions to be videotaped in non-pixelated video in Windows file format.

3.15 **BIM PROTOCOLS**

The following protocols apply to the production, use of, and limits of the electronic model used by, or created by Hendrix Consulting Engineers (HCE) as part of the project Building Information Modeling (BIM) process and specific to the Mechanical, Electrical, Plumbing (MEP) systems or this part of the Project designed by HCE.

The definitions, terms and limits, and descriptions herein shall supersede any contract terms and conditions relating to BIM, or BIM Execution Plan, or similar BIM article(s), when applied to HCE, included as part of the Project.

Purpose of the Model:

The electronic model is an instrument of service, intended for the production of 2-Dimensional (2D) Contract Documents via a 3-Dimensional (3D) design and coordination process. Hendrix Consulting Engineers (HCE) may choose to model those elements determined suitable for 3D coordination. However, the model will not include all elements necessary for complete MEP systems design and installation nor will it include all elements and requirements reflected on the 2D Contract Documents, which include the Project drawings and specifications.

Expectations for Limits of Modeled Elements:

The model will be used for coordination between design team members as outlined in the Level of Development section below. At the onset of the Project, the design team will agree on the limits of modeled elements.

Generally, modeled elements will include the following:

- HVAC: Pipes greater than 3" (nominal size, not including insulation), ductwork modeled at a design level for general design intent, equipment, and diffusers, registers, grilles, and louvers.
- Plumbing: Piping greater than 3' (nominal size, not including Insulation), equipment, fixtures.
- Electrical: Light fixtures, distribution equipment and panels.

The model will generally **not** include the following:

- Flanges, fittings, hangers, pull boxes, seismic restraints, and other assembly data subject to the means and methods of construction.
- Thermostats, sensors, detectors, switches, and other wall/ceiling devices denoted by symbol on the plans.
- Dampers and duct accessories with some exceptions at the discretion of HCE.
- Valves and pipe specialties with some exceptions at the discretion of HCE.
- Specific connections to equipment with some exceptions at the discretion of HCE.
- Exterior pipe and duct Insulation and interior ductwork liner will **not** be modeled.
- Fire Protection systems other than the main piping and components used to develop the performance design.
- Conduit and panels for automated control systems
- Conduit and devices for Fire Alarm systems
- Other "performance design" elements will **not** be modeled
- Accurate quantities suitable for estimating, construction, or cataloguing.
- Specific manufacturer information other than where HCE, at its sole discretion, chooses to include such information.
- Representation or controlling criteria in regard to the sequencing of construction. Any such information presented by the model is coincidental.
- Fully coordinated systems.

Other stipulations:

- Under no conditions may the model be used for fabrication or quantity take-offs.
- If the model is forwarded to the Contractor and/or subcontractors, the Contractor and subcontractors may only use the model as a reference-only model to understand design intent.

As noted herein, the model is an instrument of service. As such, any Information contained in the model is subordinate to the printed, 2D Contract Documents. In the case of any conflicts or differences, the 2D Contract Documents are the controlling documents.

Level of Development (LOD):

The following LOD descriptions shall apply to the work performed by, and model provided by, Hendrix Consulting Engineers (HCE). These descriptions include the content requirements and associated authorized uses for each progressively detailed LOD. Each subsequent LOD builds on the previous LOD. The model content requirements apply only to those systems, components, and assemblies HCE chooses to include within the model. The authorized uses noted herein constitute the only allowed uses of the model.

LOD 100

Model Content Requirements. Basic spatial requirements and system concepts used to support the development of the architectural model. Systems and components are not modeled for dimensional or location accuracy.

Authorized Uses. The model may be used to generate 2D drawings representing the design concept. The model may be used by the design team for developing concepts and coordination criteria.

Application. An LOD 100 model will apply to Concept Design and Schematic Design phases.

LOD 200

Model Content Requirements. Model elements are modeled as generalized systems, components, or assemblies with approximate quantities, sizes, shapes, and locations and shall not be considered as "dimensionally accurate." Non-geometric information may be attached to Model Elements at the sole discretion of HCE. While modeled elements are intended to support the coordination process, modeled elements shall not be considered coordinated at this LOD.

Authorized Uses. The model may be used to generate 2D drawings representing the status of the design. The model may be used by the design team to coordinate rights-of-way for major system components. The model may be used for clash detection by the design team within the limits of expectations defined herein. HCE will not respond to itemized clash reports at this level as modeled elements are not considered coordinated at this level. Clash detection reports will be used as coordination for CD phase documentation only.

Application. An LOD 200 model will apply to the Design Development phase.

LOD 300

Model Content Requirements. Model elements are modeled as generalized systems, components, or assemblies with approximate quantities, sizes, shapes, and locations and shall not be considered as "dimensionally accurate." Non-geometric Information may be attached to Model Elements at the sole discretion of HCE. At this LOD and at the sole discretion of HCE, specific model elements accurate in terms of size and shape may be included. These elements may or may not be imported from specific manufacturers in order to define a basis of design. Where equipment elements are shown, HCE makes no representation of the accuracy of the elements since any manufactured equipment or component is subject to continual change and alternate manufacturers are typically permitted. While modeled elements are intended to support the coordination process at a more detailed level, modeled elements shall not be considered completely coordinated at this LOD.

Authorized Uses. The model may be used to generate 2D drawings representing the status of the design. The model may be used by the design team to coordinate rights-of-way for major system components, primary system components, and secondary distribution components. The model may be used for clash detection by the design team within the limits of expectations defined herein.

Application. An LOD 300 model will apply to the Contract Document phase.

LOD 400:

Model Content Requirements. Model elements are modeled as specific systems, components, or assemblies that are accurate in terms of size, shape, location, and quantity with fabrication, assembly, and detailing information. Non-geometric information may be attached to Model Elements. Where possible, elements are modeled from actual manufacturer's data to include information specific to the selected manufacturers.

Authorized Uses. The Contractor may choose to produce an LOD 400 model to generate 2D coordination drawings and/or for detailed, 3D installation coordination among the construction team. During this process the design model, which is not an LOD 400 model, may be used by the construction team as a reference-only document to help clarify the design Intent.

Application. An LOD 400 model will apply to the Shop Drawing and Construction Coordination phases and is the responsibility of the Contractor. The Scope of Work for Hendrix Consulting Engineers (HCE) does not include an LOD 400 model.

LOD 500:

Model Content Requirements. Model elements are modeled as actual constructed (As-built) systems, components, and assemblies accurate in terms of size, shape, location, and quantity. Non-geometric Information including Operation and Maintenance Data and linked submittal data is attached to Model Elements where applicable.

Authorized Uses. The model may be used for maintaining, altering, and adding to the Project, but only to the extent consistent with any license granted in other binding Agreements or Contracts or in a separate licensing agreement.

Application. An LOD 500 model will apply to the As-Built phase and is the responsibility of the Contractor. The Scope of Work for HCE does not include an LOD 500 model.

Clash Detection:

It is expected clash detection will be performed by the design team to aid in design coordination. Due to the limits of available software, elements identified as "clashing" may not actually be in conflict and should not be construed as conflicts or errors on the part of the design team. If clash detection will be utilized, an agreement will be made as to what constitutes a "clash" and when resolution of clashes is required. The model is a design tool rather than an installation tool. Therefore, some clashes are expected and may be left in place where a construction resolution is available.

Insomuch as we do not have complete control over the design, selection of materials, or sequencing of construction for the Project, HCE makes no representation that the model will be "clash-free" or without conflicts requiring resolution by the Contractor during the formal production of Shop Drawings and field Coordination Drawings.

Availability of Model.

The model will be made available subject to the Terms of the Prime Agreement.

Contractor's Role:

The Contractor is solely responsible for the decisions made for their use of the model. The Contractor is ultimately responsible for the complete and coordinated installation of all systems depicted on the Contract Documents, whether or not said systems are completely depicted within the model. The model, as an instrument of service, is not intended to dictate means and methods, scheduling requirements, sequencing, or exact quantities; these requirements are the sole responsibility of the Contractor.

Integrated Project Teams:

When integrated project teams, such as Design/Assist, Design/Build, Lean Design, or CM/GC, are part of the project the terms herein shall still apply. However, the project team may alter certain aspects of these terms to allow shared roles in regard to the development of the model. Any such alterations must be approved by HCE and Shall be implemented without additional liability to HCE.

Ownership of Documents:

The model, and all documents produced by Hendrix Consulting Engineers (HCE) under this agreement shall remain the property of HCE and may not be used by the Client for any other endeavor without the written consent of HCE.

MEP/ENERGY CONSULTANTS



115 East Main Street

COMMISSIONING • FIELD INVESTIGATIONS

Round Rock, Texas 78664

PH: (512) 218-0060

FIRM F-4095

FAX: (512) 218-0077

PRE-CONSTRUCTION INSTRUCTION SHEET

Submittal/RFI Requirements

- A. 'Individual submittals' means separate submittals with unique submittal numbers. One single giant PDF will be rejected.
- B. 2 Submittal CATEGORIES (Reference Specifications)
 - a. Not required unless deviating from specification
 - b. PDF allowed.

PDF SUBMITTAL/RFI FILE TITLE REQUIREMENT:

For submittal sections listed below as allowed pdf's the following requirements must be met or the submittal will not get through email security and will be auto-deleted and not checked. Each pdf submittal must be a separate pdf file.

PDF FILE: MUST BE NAMED AS FOLLOWS:

JOB NAME – SUBMITTAL No. XX – SUBMITTAL DESCRIPTION

JOB NAME – RFI No. XX – RFI DESCRIPTION

Example: Texas ISD ES No. 2 – Submittal 8 – Plumbing Fixtures

Example: Texas ISD ES No. 2 – RFI 3 – Library Light Fixture Mounting Height

EMAIL TITLE/SUBJECT REQUIREMENTS:

Emails without Job Name and proper format will not get through email security and will be auto-deleted and not checked.

JOB NAME – SUBMITTAL No. XX – SUBMITTAL DESCRIPTION

JOB NAME – RFI No. XX – RFI DESCRIPTION

- C. If submittals are submitted early relative to construction phasing, submittals may be held, reviewed and returned at the appropriate time for construction phasing, not necessarily 2 weeks. In some cases, if submittals are received vastly out of order of construction, submittal may be rejected.

- D. Time Critical Submittal Coordination Items

Mechanical to provide to General Contractor for Structural Roof Coordination

- a. Mechanical to provide roof opening shop drawing as early as possible for structural coordination. Per specifications.

Mechanical to provide to General and Electrical Contractors for Gear Coordination

- b. Mechanical to complete "MECHANICAL/ELECTRICAL COORDINATION SHEET" prior to electrical gear submittals for coordination with electrical contractor. Per specifications.

- E. **Do not submit non pre-approved substitutions during submittal time. These submittals will be automatically REJECTED. Substitution Pre-approval was at bid time.**
- F. **Review time for multiple resubmittals of non-approved equipment will result in Contractor being billed for review time that is not part of Engineer's Scope. Engineer will bill Contractor at Engineer's Current hourly rates.**
- G. **Email of all Submittals/RFI's must go directly to Architect. Do not Copy Engineer.**
- H. **Engineer is not the Contractors plan reference resource. Do not submit an RFI until drawings and specifications have been reviewed first. If the answer is clearly on the drawings the response will be "The answer is clearly on the drawings, Engineer is not the Contractors plan reference resource."**
- I. **Call before submitting a written RFI.**
- J. **All formal Job emails must come from Architect.**
- K. **Do not email send recurring jobsite meeting requests to Engineer. Engineer does not attend all weekly meetings. Architect will coordinate when Engineer is to be required at job site for specific meetings.**
- L. **All equipment that will be controlled by or monitored by the DDC System must include the information needed by the Controls Contractor to properly integrate the equipment with the Controls System.**
- M. **All equipment submittals to include a detail instruction on what needs to be set up in the field when the equipment is started up and step-by-step instructions on how to complete the set-up. Do not submit generic information that covers multiple types of equipment. The instructions must be specific to the equipment scheduled with all of the accessories and sequences specified.**

Shop Drawings and Cad Files

- A. Contractor Shop Drawings must use Architectural Backgrounds and Architectural RCP's (when available or lighting floorplan) and **Mechanical Contractor Shop Drawings** for coordination purposes. Do not request MEP floorplans, this will be cut and paste into an email for you to read. Engineer cannot send architectural backgrounds.
- B. If no Architectural RCP is available for light locations. Lighting Floorplans will be released.
- C. Mechanical Floorplan will be released to Mechanical Contractor for aid in production of his own shop drawings. HCE mechanical drawings may not be submitted as shop drawings.
- D. Fire Alarm, Sprinkler, Intercom etc. all to use Architectural Backgrounds, must be obtained from Architect.
- E. Schedule and Details sheets will not be released.

MEP/ENERGY CONSULTANTS



SUBSTITUTION REQUEST

FROM: _____ DATE: _____

PROJECT: _____

RE: _____

COMMISSIONING • FIELD INVESTIGATIONS *The following has been submitted for consideration on the aforementioned project:*

Specification Title, Section, Page and Article/Paragraph: _____

Drawings and Details Affected: _____

Proposed Substitution/Description: _____

Installer's Name: _____

Manufacturer's name: _____

Point by Point Comparative Data attached - REQUIRED BY A/E (_____ # of pages including cover)

Why is Substitution Being Submitted?

- Pre-Bid Substitution (Prior Approval): Include detailed analysis comparing proposed substitution against specified product, including redlined Specifications showing differences or deviations.
- Specified product is not available. Explain in detail as attachment.
- Cost Savings to Owner. Indicate comparative cost analysis as attachment.
- Other. Explain.

Effects of Proposed Substitution?

(Attach complete explanations and technical data, including laboratory test, if applicable.) Include complete information changes to Drawings and/or Specification that proposed substitution would require for its proper installation. Fill in blanks below:

- A. Does substitution affect dimensions shown on drawings? No Yes
- B. Will undersigned pay for changes to building design, including engineering and detailing costs caused by requested substitution? No Yes
- C. What affect does substitution have on other trades?

- D. Differences between proposed substitution and specified item?

- E. Indicate how proposed substitution meets LEED requirements. (if applicable)
- F. Manufacturer's guarantees of proposed and specified items are:
 Same Different (explain on attachment)

- The Contractor and Subcontractor certifies:
- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
 - Same warranty will be furnished for proposed substitution as for specified product.
 - Similar maintenance service and source of replacement parts, as applicable is available.
 - Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
 - Proposed substitution does not affect dimensions and functional clearances.
 - Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.

Submitted By: (name, address, telephone and contact person of manufacturer and installer of proposed substitution)

For A/E Use: SR# _____

Accepted Accepted as Noted
 Not Accepted Received Too Late
 Incomplete Information
 No Substitutions Accepted

Reviewed by/date: _____
 Comments: _____

Subcontractor's signature and date: _____

Contractor's signature and date: _____

COPY TO:
 FILE OWNER CONTRACTOR
 ENGINEER _____



115 E. Main Street
 Round Rock, Texas 78664
 (512)218-0060-office
 (512)218-0077-fax



Pre - Wall Cover-Up Contractor Readiness Checklist

THE FOLLOWING ITEMS ARE COMMON ITEMS NOTED FOR THIS INSPECTION AND MUST BE CHECKED IN EVERY ROOM PRIOR TO REQUESTING AN ABOVE CEILING INSPECTION FOR THAT ROOM.

GENERAL ITEMS:

Completed () / Initials

- / _____ ITEM NO.1: WHERE EXTERNAL INSULATION TERMINATES, SEAL INSULATION TO DUCTWORK WITH MASTIC AND 3" GLASS FIBER REINFORCING MESH PER SPECIFICATION SECTION '20 07 00, 3.04, C.'
- / _____ ITEM NO.2: FOR ALL ROOF MOUNTED MECHANICAL EQUIPMENT, ONLY CUT ROOF DECK FOR DUCT DROPS. SPECIFICATION SECTION
- / _____ ITEM NO.3: WHEN REFRIGERANT PIPING IS LOCATED BEHIND WALLS, INSURE REFRIGERANT PIPING DOES NOT COME IN CONTACT WITH STEEL STUDS OR CLAMPS, AND HAS NAIL/SCREW PROTECTION AT STUDS. SPECIFICATION SECTION
- / _____ ITEM NO.4: RAINLEADER PIPE SIZE MAY NOT BE REDUCED IN DIRECTION OF DISCHARGE, MUST REMAIN FULL SIZE INCLUDING DROPS. RAINLEADER PIPING, RAINLEADER BODY AND FLANGES MUST BE INSULATED PERS SPECIFICATION
- / _____ ITEM NO.5: HORIZONTAL MC CABLE IS NOT ALLOWED IN WALL CAVITY. SPECIFICATION SECTION
- / _____ ITEM NO.6: FOR ALL DEVICE ROUGH-IN NEAR DOOR, FOLLOW DETAIL ON ELECTRICAL SHEETS. USE CADDY BRACKETS TO GET MULTIPLE DEVICES IN SINGLE STUD SPACE. ALL SWITCHES, THERMOSTATS, INTERCOM BUTTONS, WALL FIRE ALARM DEVICES INSTALLED BY DOOR PER ROUGH-IN DETAIL DEVICES SHOULD NOT EXTEND OVER 24" FROM DOOR FRAME. NO DEVICES SHOULD BE ROUGHED-IN, THAT WOULD CONFLICT WITH CABINETS OR WHITE BOARDS. ITEMS DEVIATING FROM DETAIL THAT CAUSE OWNER PROBLEMS WILL BE RELOCATED EVEN AFTER SHEETROCK INSTALLED. SPECIFICATION SECTION
- / _____ ITEM NO.7: ALL EXPOSED EXTERIOR CONDUIT FROM GRADE TO PANEL OR 36" AND BELOW, MUST BE RIGID PIPE. CONDUIT NOT FOLLOWING SPECIFICATION WILL HAVE TO BE REMOVED

AND REPLACED, EVEN IF WIRE HAS ALREADY BEEN PULLED. PAY SPECIAL ATTENTION TO EXTERIOR RACK MOUNTED SERVICES. SPECIFICATION SECTION

/ _____ ITEM NO.8: ALL CONDUIT AND J-BOX STRAPS AND SPACING MUST BE PER CODE.

/ _____ ITEM NO.9: TECHNOLOGY AND POWER TO BE WITHIN 6" OF EACH OTHER OR IN SAME STUD SPACE WHEN SHOWN TOGETHER. REFERENCE POWER AND TECHNOLOGY PLANS. REFERENCE BLOCK NOTE ON POWER PLANS. DEVICES INTENDED TO BE LOCATED NEXT TO EACH OTHER THAT ARE NOT IN THE SAME STUD SPACE WILL BE RELOCATED, EVEN AFTER SHEETROCK. SPECIFICATION SECTION

/ _____ ITEM NO.10: CONFIRM TRANSFER DUCTS INSTALLED IN ALL WALLS TO DECK WHEN SHOWN ON PLANS OR REQUIRED FOR RETURN AIR PATH. PROVIDE PLAN HIGHLIGHTING ALL WALLS TO DECK AND INSTALLED TRANSFERS. SPECIFICATION SECTION

/ _____ ITEM NO.11: WHEN CONDUIT PENETRATES FLOOR, HOLES IN SUSPENDED SLABS, HOLES MUST BE SEALED FROM TOP AND BOTTOM PRIOR TO CLOSING UP WALLS. SPECIFICATION SECTION

/ _____ ITEM NO.12: PROVIDE DRAWING SHOWING LOCATION AND SIZE OF ALL WATER HAMMER ARRESTORS INSTALLED. MUST BE INSTALLED AND SIZED PER SPECIFICATION AND MANUFACTURERS INSTALLATION INSTRUCTION. SPECIFICATION SECTION

/ _____ ITEM NO.13: ENSURE GROUNDING/BONDING BUSHINGS ON ALL PANEL CONDUITS AND GROUNDING CONDUITS FROM TRANSFORMERS. SPECIFICATION SECTION

THE CONTRACTOR SHALL RESPOND IN WRITING THAT ALL DEFICIENCIES HAVE BEEN CORRECTED. SEND RESPONSE BACK TO ARCHITECT.

Signature of Person Completing Readiness Checklist. _____ Date _____



Pre - Above Ceiling Contractor Readiness Checklist

THE FOLLOWING ITEMS ARE COMMON ITEMS NOTED FOR THIS INSPECTION AND MUST BE CHECKED IN EVERY ROOM PRIOR TO REQUESTING AN ABOVE CEILING INSPECTION FOR THAT ROOM.

GENERAL ITEMS:

Completed () / Initials

- / _____ ITEM NO.1: CONFIRM ALL RUN OUT TAPS HAVE BALANCING DAMPERS WITH STAND-OFF MOUNTING BRACKETS PER SPECIFICAN AND DETAILS. SPECIFICATION SECTION
- / _____ ITEM NO.2: CONFIRM ALL EXHAUST DUCT WITHIN 36" OF ROOF DECK OR EXTERIOR WALL IS INSULATED PER PLANS AND SPECIFICATIONS. SPECIFICATION SECTION
- / _____ ITEM NO.3: CONFIRM RETURN AIR PATH BACK TO ALL UNITS IS NOT BLOCKED BY WALLS TO DECK. CONFIRM ALL TRANSFERS HAVE BEEN INSTALLED. PROVIDE PLAN HIGHLIGHTING WALLS TO DECK AS INSTALLED AND HIGHLIGHTING AIR TRANSFERS INSTALLED FOR REVIEW. THIS IS FOR REVIEW TO CONFIRM IF ANY ADDITIONAL TRANSFERS ARE REQUIRED OR OPENING ABOVE CEILING NEED TO BE CUT INTO SHEET ROCK ON WALLS TO DECK PRIOR TO CEILING COVER UP. SPECIFICATION SECTION
- / _____ ITEM NO.4: REFRIGERANT PIPING: CONFIRM ALL REFRIGERANT PIPING IS COMPLETELY INSULATED AND INSULATION SEALED, INCLUDING CONTINUOUSLY THROUGH WALLS. ENSURE PIPE SADDLES ARE INSTALLED AT ALL SUPPORTS FOR REFRIGERANT PIPING. SPACING PER SPECIFICATIONS
- / _____ ITEM NO.5: CONFIRM BACK OF ALL SUPPLY GRILLES ARE INSULATED. SPECIFICATION SECTION
- / _____ ITEM NO.6: ALL EXTERIOR LIGHTS SEALED TO BUILDING.
- / _____ ITEM NO.7: CONFIRM ANY DAMAGED INSULATION FOR DUCTWORK, WATER PIPING, REFRIGERANT PIPING IS REPAIRED AND PROPERLY SEALED TO PREVENT CONDENSATION.

SPECIFICATION SECTION

- / _____ ITEM NO.8: CONFIRM ALL PENETRATIONS THROUGH FIRE WALLS HAVE BE CAULKED. SPECIFICATION SECTION
- / _____ ITEM NO.9: CONFIRM ACCESS DOORS ARE PROVIDED FOR ALL FIRE/SMOKE DAMPERS AND OTHER REQUIRED LOCATIONS, PER DETAILS, SPECIFICATIONS FOR ACCESS TO REQUIRED COMPONENTS. ENSURE ACCESS DOORS ARE PROVIDED IN DUCTWORK AS DECRIBED IN RTU AND AHU DETAILS AT FIRST 90° TURN FOR RTU AND BOTH SUPPLY AND RETURN OF AHU. REFERENCE SPECIFICATION FOR PROPER SIZE AND SPACING.
- / _____ ITEM NO.10: CONFIRM ALL MECHANICAL UNITS, WATER HEATERS, PANELBOARDS, TRANSFORMERS ETC.. ARE LABELED WITH ALL REQUIRED INFORMATION AND WITH PROPER MATERIAL PER SPECIFICATION '20 01 00, 3.05, B'.
- / _____ ITEM NO.11: CONFIRM ALL CABLES ARE INDEPENDANTLY SUPPORTED PER SPECIFICATIONS. CONTROLS, FIRE ALARM, LIGHTING CONTROL, POWER, TECHNOLOGY, INTERCOM ETC.. SPECIFICATION SECTION
- / _____ ITEM NO.12: CONFIRM INSULATION IS SEALED AT ALL HANGERS. SPECIFICATION SECTION
- / _____ ITEM NO.13: CONFIRM ISOLATORS ARE INSTALLED AT ALL EQUIPMENT AS REQUIRED BY SPECIFICATION AND DETAILS. SPECIFICATION SECTION
- / _____ ITEM NO.14: FOR ALL EXTERIOR EQUIPMENT: CONFIRM HAIL GUARDS ARE INSTALLED IMMEDIATELY WHEN UNIT IS INSTALLED AT SITE TO PREVENT HAIL DAMAGE FROM OCCURRING. HAIL DAMAGE DURING CONSTRUCTION DUE TO NOT INSTALLING HAIL GUARDS IS CONTRACTORS' RESPONSIBILITY. SPECIFICATION SECTION
- / _____ ITEM NO.15: ROOF MOUNTED CONDENSING UNITS: CONFIRM ALL ROOF MOUNTED CONDENSING UNIT ARE INSTALLED ON THY-CURBS, ALL METAL CROSS SUPPORTS ARE GALVANIZED AND CUT ENDS ARE PAINTED WITH GALVANIZED PAINT. ALL CONDENSING UNITS MUST BE PROPERLY SECURED TO THY-CURB PER DETAIL. NO PENETRATIONS ALLOWED IN TOP OF THY CURB. INSURE ALL SIDE DISCHARGE CONDENSING UNIT ARE AIMED CORRECTLY AND NOT BLOWING INTO INTAKE OF ADJACENT CONDENSING UNIT. INSURE ALL SIDE DISCHARGE CONDENSING UNIT HAVE AIR DIRVERTER INSTALLED CORRECTLY IN THE UP POSITION. SPECIFICATION SECTION
- / _____ ITEM NO.17: EXTERIOR REFRIGERATION PIPING: ENSURE ALL EXTERIOR REFRIGERANT PIPING INSULATION IS WEATHER

PROOFED WITH ALUMINUM WRAP PER SPECIFICATIONS.
SUPPORTED PROPERLY AND INSTALLED IN MANNER THAT
DOES NOT IMPEAD MAINTANANCE ACCESS.
SPECIFICATION SECTION

- / _____ ITEM NO.19: INSULATION THROUGH WALLS: VERIFY ALL DUCTWORK, PIPING, AND REFRIGERATION PIPING INSULATION IS CONTINUOUS THROUGH WALLS. BREAKS IN INSULATION INSIDE WALL WILL CAUSE CONDENSATION AND MOLD
SPECIFICATION SECTION

- / _____ ITEM NO.21: PIPING LABELING: CONFIRM ALL PIPING IS LABELED WITH WATER TYPE AND DIRECTIONAL ARROWS, WITH PROPER COLOR, SIZE, SPACING PER SPECIFICATION SECTION '20 01 00, 3.09, C'.

- / _____ ITEM NO.22: CONFIRM ALL VALVES ARE TAGGED PER SPECIFICATION SECTION '20 01 00, 3.05, A'. PROVIDE MAP OF ALL LOCATION IN PDF FORM TO OWNER.

- / _____ ITEM NO.23: PROVIDE CEILING ACCESS MARKERS FOR ALL MECHANICAL UNITS, VALVES, ETC... PER SPECIFICATION SECTION '20 01 00, 3.05, D'.

- / _____ ITEM NO.25: INSURE ALL REFRIGERANT PIPING, WATER PIPING AND DUCTWORK SUPPORTS ARE PROVIDED PIPE SADDLES UNDER HANGERS AS REQUIRED FOR ALL LOCATIONS. SUPPORT SPACING MUST BE PER SPECIFICAITONS

- / _____ ITEM NO.26: EXTERIOR MEP PENETRATIONS: ALL PENETRATION THROUGH EXTERIOR WALLS/DRAIN PLANES MUST BE SEALED WATERTIGHT PER DETAILS AND SPECIFICATIONS. INCLUDING BUT NOT LIMITED TOO: RAINLEADER, CONDUIT, HOSE BIBBS, REFRIGERANT PIPING, FIRE SPRINKLER TEST PIPE, LIGHT FIXTURES, RECEPTACLES, WATER PIPING PENETRATIONS ETC... SPECIFICATION SECTION

- / _____ ITEM NO.28: PIPING SUPPORTS: ENSURE PROPER PIPING SUPPORTS ARE USED TO SUPPORT DISSIMILAR METALS PER SPECIFICATION SECTION

- / _____ ITEM NO.29: GAS PIPING ON ROOF: ALL BRANCH GAS TAP MUST BE TAPPED OFF TOP OF MAIN GAS LINE. DIRT LEG MUST BE INSTALLED AT ALL UNIT CONNECTIONS MINIMUM 3" ABOVE ROOF. ALL GAS PIPING MUST BE PRIMED AND PAINTED. MUST BE SUPPORTED WITH PPH TYPE ROLLER SUPPORTS WITH PROPER SPACING PER SPECIFICATION SECTION

- / _____ ITEM NO.30: PEX PIPING SUPPORTS (WHEN USED): INSURE CORRECT PEX ISOLATION FITTINGS ARE BEING USED TO SUPPORT PEX PIPING IN WALL. CONFIRM CORRECT CONTINUOUS PEX SADDLE SUPPORT IS BEING USED FOR PEX ABOVE CEILING, TO MAINTAIN FLAME SMOKE RATING.

SPECIFICATION SECTION

- / _____ ITEM NO.33: LABEL ALL J-BOXES WITH CIRCUIT AND PANEL NUMBERS. SPECIFICATION SECTION
- / _____ ITEM NO.34: CONFIRM ALL TRANSFORMER GROUND CONNECTIONS HAVE BEEN INSTALLED. SPECIFICATION SECTION
- / _____ ITEM NO.35: CONFIRM ALL UNUSED OPENINGS IN JUNCTION BOXES ARE PROPERLY SEALED. SPECIFICATION SECTION
- / _____ ITEM NO.36: CONFIRM REMOVAL OF ALL TEMPORARY AND UNUSED WIRING AND LIGHTING WHEN APPROPRIATE. SPECIFICATION SECTION
- / _____ ITEM NO.37: CONFIRM LABELING AND PAINTED RED ALL FIRE ALARM JUNCTION BOXES. SPECIFICATION SECTION
- / _____ ITEM NO.38: CONFIRM ALL J-BOXES ABOVE CEILINGS ARE ACCESSIBLE. SPECIFICATION SECTION
- / _____ ITEM NO.39: CONFIRM ALL FLEX CONDUIT ABOVE CEILING IS INDEPENDENTLY STRAPPED. SPECIFICATION SECTION
- / _____ ITEM NO.40: CONFIRM DUCT DETECTORS ARE INSTALLED WHERE REQUIRED. REFERENCE UNIT SCHEDULE, FIRE ALARM SHOP DRAWINGS AND UNITS OVER 2000 CFM. REFERENCE SPECIFICATION SECTION
- / _____ ITEM NO.41: CONFIRM ALL CEILING MOUNTED EXIT SIGNS ARE SECURED TO STRUCTURE. SPECIFICATION SECTION
- / _____ ITEM NO.42: CONFIRM ALL LIGHT FIXTURES HAVE INDEPENDENT SUPPORTS ON MINIMUM 2 CORNERS AND CONFIRM THEY ARE SECURED TO STRUCTURE. SPECIFICATION SECTION
- / _____ ITEM NO.44: ROOF MOUNTED TRANSFORMERS AND PANELS: INSTALL ON THY-CURBS PER DETAIL. ALL STEEL CROSS SUPPORT TO BE HOT DIP GALVANIZED, CUT ENDS PAINTED WITH GALVANIZING PAINT. PROVIDE FOOTPLATE AND RUBBER ISOLATER PAD UNDER FEET OF TRANSFORMER. PROPERLY SECURE TRANSFORMER AND PANEL TO SUPPORT, DO NOT PENETRATE TOP OF THY CURB. DO NOT LEAVE METAL SHAVINGS CAUSING RUST WHEN CUTS ARE MADE. SPECIFICATION SECTION

THE CONTRACTOR SHALL RESPOND IN WRITING THAT ALL DEFICIENCIES HAVE BEEN CORRECTED. SEND RESPONSE BACK TO ARCHITECT.

Signature of Person Completing Readiness Checklist. _____ Date _____



Pre - Final Punch Inspection Contractor Readiness Checklist

THE FOLLOWING ITEMS ARE REQUIRED TO BE ADDRESSED AND SIGNED OFF IN WRITING BY CONTRACTOR FOR EACH UNIT OR ROOM AS INDICATED BY INDIVIDUAL ITEMS BELOW. THESE ITEMS MUST BE COMPLETED AND SUBMITTED WITH ANY DEFICIENCIES CORRECT PRIOR TO REQUESTING FINAL MEP INSPECTION.

GENERAL ITEMS:

COMPLETED () / INITIALS

- / _____ ITEM NO.1: ALL MECHANICAL UNITS: PROVIDE CONTRACTOR READINESS CHECKLIST (START-UP FORMS),
- MECHANICAL CONTRACTOR - START-UP REPORTS
 - MANUFACTURER START-UP FORM (WHEN REQUIRED)
 - MECHANICAL START-UP FORM
 - CONTROLS START-UP FORM
 - TEST-BALANCE WITH ALL DEFICIENCIES ADDRESSED.
 - COMMISSIONING FOR ALL MECHANICAL UNITS AS LISTED IN SPECIFICATION. SCHEDULE OF VALUE LINE ITEM WILL NOT BE PAID UNTIL ALL FORMS FOR ALL EQUIPMENT HAVE BEEN COMPLETED, SUBMITTED AND REVIEWED. PARTIAL PAYMENT WILL NOT BE PROVIDED. SPECIFICATION SECTION 20 00 00.
- / _____ ITEM NO.2: PROVIDE TEST AND BALANCE REPORT WITH ALL DEFICIENCIES ADDRESSED AND WITH DISCHARGE AIR TEMPS IN COOLING MODE PER SPECIFICATIONS.
- / _____ ITEM NO.3: CONFIRM ALL THERMOSTATS CALIBRATED AND ADJUSTED TO + OR - 1 DEGREE ACCURACY. PROVIDE SIGNED FORM FOR ALL SENSORS.
- / _____ ITEM NO.4: CONFIRM LABELING ALL THERMOSTATS PER SPECIFICATION SECTION '20 01 00, 3.05, C.'.

- / _____ ITEM NO.5: DUCTWORK AND INSIDE OF MECHANICAL UNITS TO BE CLEANED.
- / _____ ITEM NO.6: CLEAN SET OF FILTERS TO BE INSTALLED IN ALL UNITS.
- / _____ ITEM NO.7: CHECK DISCHARGE AIR TEMPERATURE OFF OF ALL COOLING UNITS. (INCLUDE DISCHARGE AIR IN COOLING FOR EACH STAGE OF COOLING, MUST BE 56 DEGREES OR COOLER, REFERENCE START-UP FORMS)
- / _____ ITEM NO.8: CHECK DISCHARGE AIR TEMPERATURE AND HUMIDITY OFF OF ALL MAKEUP/OUTSIDE AIR UNITS. (MUST BE 53 DEGREES OR COOLER OFF COIL)
- / _____ ITEM NO.9: PROVIDE LABEL AND DIRECTIONAL ARROWS ON BOTH SIDES OF LABELS ON ALL PIPING PER SPECIFICATION SECTION '20 01 00, 3.09, C.', INCLUDING ABOVE CEILING AND WATER HEATER ROOMS.
- / _____ ITEM NO.10: TAG ALL VALVES PER SPECIFICATION SECTION '20 01 00, 3.05, A.'
- / _____ ITEM NO.11: PROVIDE CEILING ACCESS MARKERS PER SPECIFICATION SECTION '20 01 00, 3.05, D.'
- / _____ ITEM NO.12: LABEL ALL EQUIPMENT PER SPECIFICATION SECTION '20 01 00, 3.05, B.'
- / _____ ITEM NO.13: SINKS:
- CONFIRM ALL EXPOSED SINK WASTE PIPE HAS 'ADA' PADDING INSTALLED.
 - CONFIRM TMV LOCATED AT EACH SINK REQUIRED ON PLUMBING FIXTURE SCHEDULE.
 - PROVIDE AS BUILT OF WATER HAMMER ARRESTORS SIZE AND LOCATION.
- / _____ ITEM NO.14: LABEL PANELBOARDS PER SPECIFICATION SECTION '26 05 00, 3.09, K. INCLUDE ALL INFORMATION REQUIRED, AND TYPED PANELBOARD SCHEDULES WITH ROOM NAMES.
- / _____ ITEM NO.15: PROVIDE FACTORY START-UP AND PROGRAMMING OF 'NLIGHT' LIGHTING CONTROLS. PROVIDE DOCUMENTATION THAT THIS FACTORY PROGRAMMING HAS OCCURRED.

/ _____ ITEM NO.16: PROVIDE DOCUMENTATION THAT MANUFACTURER ONSITE TESTING HAS BEEN COMPLETED FOR SURGE PROTECTION.

/ _____ ITEM NO.17: PROVIDE DOCUMENTATION FOR TRANSFORMERS THAT MANUFACTURER HAS VERIFIED CONNECTIONS AND TESTED USB PORT FUNCTION.

/ _____ ITEM NO.18: CLEAN ALL CONSTRUCTION DEBRIS FROM INSIDE UNITS AND ON ROOF.

/ _____ ITEM NO.19: VERIFY THAT MECHANICAL CONTROL SYSTEM IS COMPLETE.

- ENSURE THAT ACCESS TO CONTROLS IS CONNECTED AND OPERATIONAL.
- OWNER SCHEDULE HAS BEEN INPUT.
- ALL SEQUENCES OF OPERATION FUNCTION PROPERLY
- ALL CONTROL START-UP FORMS COMPLETED AND SUBMITTED.
- ENGINEER WILL REQUIRE ACCESS TO CONTROL SYSTEM DURING FINAL VISIT. PROVIDE ACCESS CODES AND PASSWORDS TO ENGINEER.

/ _____ ITEM NO.20: ALL MECHANICAL, ELECTRICAL AND PLUMBING EQUIPMENT MUST BE POWERED UP AND OPERATIONAL.

/ _____ ITEM NO.21: PAINT AND PRIME ALL GAS PIPING PER SPECIFICATIONS.

/ _____ ITEM NO.22: ROOF SUPPORTS:

- PROVIDE CARRY TREAD / WALK PAD UNDER ALL ROOF SUPPORTS (GAS PIPING, CONDENSATE DRAINS, ETC.) REFERENCE ROOFING SPECIFICATION FOR ALL REQUIREMENTS.
- SUPPORTS PROVIDED PER SPACING REQUIREMENTS IN SPECIFICATIONS.

/ _____ ITEM NO.23: VERIFY INSTALL AND TEST DRAIN PAN FLOAT SWITCH.

/ _____ ITEM NO.24: DUCT ACCESS DOORS: CONFIRM ACCESS DOORS ARE PROVIDED FOR ALL FIRE/SMOKE DAMPERS AND OTHER REQUIRED LOCATIONS, PER DETAILS, SPECIFICATIONS FOR ACCESS TO REQUIRED COMPONENTS. ENSURE ACCESS DOORS ARE PROVIDED IN DUCTWORK AS DESCRIBED IN RTU AND AHU DETAILS AT FIRST 90° TURN FOR RTU AND BOTH SUPPLY AND RETURN OF AHU. REFERENCE SPECIFICATION FOR PROPER

SIZE AND SPACING.

/ _____ ITEM NO.25: ALL WEATHERPROOF RECEPTACLE COVERS ARE REQUIRED TO BE METAL PER SPECIFICATION. PLASTIC NOT ALLOWED.

/ _____ ITEM NO.26: WATER HEATER INSTALLATION CONTRACTOR READINESS CHECKLIST.

/ _____ ITEM NO.27: ELECTRICAL CERTIFICATE OF COMPLETION PER SPECIFICATIONS, INCLUDING ALL GROUNDING TESTING, MEGGER READINGS REQUIRED BY SPECIFICATIONS.

/ _____ ITEM NO.28: DO NOT CALL FOR FINAL INSPECTION UNTIL ALL UNITS HAVE HAD MECHANICAL START-UP FORMS, TEST AND BALANCE, AND CONTROLS FULLY INTEGRATED AND SUBMITTED TO ENGINEER AND COMMISSIONING AGENT.

/ _____ ITEM NO.29: CONTRACTOR READINESS FORMS COMPLETE FOR EACH PIECE OF EQUIPMENT: (ATTACHED)

- MECHANICAL UNITS – AHU, RTU, MAU

- WATER HEATERS

THE CONTRACTOR SHALL RESPOND IN WRITING THAT ALL DEFICIENCIES HAVE BEEN CORRECTED. SEND RESPONSE BACK TO ARCHITECT.

Signature of Person Completing Readiness Checklist. _____ Date _____



ROOF TOP UNITS (RTU) Contractor Readiness Checklist

Roof Top Unit (RTU)

The installation contractor must check and verify all items listed below, prior to calling for a Final RTU inspection. This check list must be completed for all Roof Top Units as part of Final Inspection Readiness. The person performing the check must provide a signed form for each unit. Provide complete signed and dated for each unit prior to calling for final inspection.

- Unit installation:
 - The manufacturer's service and operating clearances have been provided and if free of conduit, piping, ductwork, etc.
 - Unit is level.
 - Hail Guards installed.
 - Unit Curb and Flashing per job details.
 - Roof deck only cut for duct drops, not entire curb dimension.
 - 2 layers of exterior sheathing installed on roof deck inside of curb for sound attenuation.
 - Permanent Label Installed
 - Door Handles installed.
- Drain pan :
 - The float switch is installed, wired to controls and has been tested.
 - Pan has been cleaned of all construction debris.
- Condensate drain:
 - Material is copper.
 - Installed per details with proper trap depth.
 - All cleanouts are installed for easy maintenance.
 - Unions installed per detail
 - Installed with the proper amount of slope.
 - Terminates at a code approved disposal point.
 - The insulation installed and sealed per detail and specification and does not have gaps.
 - Ensure proper air gap at all condensate disposal points.
- Ductwork Items:
 - Ductwork has been connected to the RTU unit as shown in detail.
 - Ductwork insulation ends have been sealed in return air of the RTU.
 - Internal duct insulation 48" past first 90 bend per detail. (unless owner request external)
 - RA internally lined per detail with sheet metal duct liner stops(unless owner request external)
 - Duct Wrap insulation has been terminated as detailed.
 - Duct insulation is continuous under duct smoke detectors.

- Duct access door on supply air after first 90 per detail.
- Duct access doors on both sides of turning vanes when installed.
- The access door in the return air plenum is installed in an easily accessible location for inspection and cleaning. (Access door not required if duct is open for plenum return)
- If an outside air duct is to be connected to Return Air Duct, it must be downstream from the return air inlet / connection.
- The first supply branch duct tap must be downstream from the duct/smoke detector.
- Duct taps not allowed within 48" past elbow.
- Unit access:
 - Ensure Filter removal access is not blocked.
 - Verify that all access doors can be opened or removed without damaging the insulation vapor barrier, per details, specifications, for all required components including Fire/Smoke dampers.
 - No ductwork, Electrical conduit, Fire Alarm Cable, or Controls Wiring to be in service access area.
 - Disconnect is not installed blocking access door.
 - Maintenance Receptacle operational.
- Gas
 -
- Follow ALL associated details
 - Rooftop Unit Curb/Flashing Detail
 - Deep Seal Trap Detail
 - Duct Drop Detail
 - Typical Gas/Condensate Piping Connection Detail

Signature of Person Completing Readiness Checklist. _____ Date_____



AIR HANDLING UNIT (AHU) Contractor Readiness Checklist

Air Handling Unit (AHU)

The installing contractor must check and verify all items listed below prior to calling for a Final AHU inspection. This check list must be completed for all Air Handling Units as part of Final Inspection Readiness. The person performing the check must provide a signed form for each unit. Provide complete signed and dated for each unit prior to calling for final inspection.

- Unit installation:
 - The manufacturer's service and operating clearances have been provided and if free of conduit, piping, ductwork, etc.
 - Spring isolators have been properly sized and installed per the manufacturer's installation instructions. Specifically, all nuts must be field adjusted for proper travel.
 - The refrigerant piping has been installed in a neat workman like manner and does not interfere with required service and operating clearances.
 - Refrigerant piping supported per refrigerant piping detail.
 - Verify unit is installed with positive slope toward condensate drain.
 - Unistrut supporting unit to be installed per detail (long direction of unit)
 - 2" filter rack installed.
- Condensate drain:
 - Installed per details with proper trap depth.
 - All cleanouts are installed for easy maintenance.
 - Installed with the proper amount of slope.
 - Terminates at a code approved disposal point.
 - The insulation is sealed per specification and does not have gaps.
 - Ensure proper air gap at all condensate disposal points.
- Auxiliary Drain pan :
 - Extends beyond air-handling unit as shown / noted in detail.
 - Has the supports installed inside and underneath the pan as shown in detail. (Long direction of pan)
 - The float switch is installed, wired to controls and has been tested.
 - A drain has been installed in Aux Drain Pan and is capped or piped off to the exterior of the building as shown or note on the drawings.
 - Pan has been cleaned of all construction debris.
 - Neoprene isolation tape has been installed between the pan and supports and between the supports and unit as shown in detail.
- Ductwork Items:
 - Ductwork has been connected to the Air Handling unit as shown in detail.
 - Ductwork has been sealed at the Air Handling unit as shown in detail.
 - Duct Wrap insulation has been terminated at the Air Handling unit as detailed.

- Duct insulation is continuous under duct smoke detectors.
- The access door in the return air plenum is installed in an easily accessible location for inspection and cleaning. (Access door not required if duct is open for plenum return)
- If an outside air duct is to be connected to Return Air Duct, it must be downstream from the return air inlet / connection.
- The first supply branch duct tap must be downstream from the duct/smoke detector.
- Unit access:
 - Verify that all access doors can be opened or removed without damaging the insulation vapor barrier, per details, specifications, for all required components including Fire/Smoke dampers.
 - Supports do not interfere with the removal of the access doors.
 - Ensure Filter removal access is not blocked.
 - Verify that all access doors can be opened or removed without damaging the insulation vapor barrier.
 - No ductwork, Electrical conduit, Fire Alarm Cable, or Controls Wiring to be in service access area.
- Unit Test and Balance completed, and ALL deficiencies resolved and provided to Engineer.
- Equipment Start-up form Completed and provided to Engineer.
- Controls Integrated and verified operational.
- Unit Discharges 58 degrees or cooling in ALL speed of cooling and recorded.

Signature of Person Completing Readiness Checklist. _____ Date _____



WATER HEATER (WH) Contractor Readiness Checklist

Water Heater (WH)

The installing contractor must check and verify all items listed below, prior to calling for a Final WH inspection. This check list must be completed for all water heating units as part of Final Inspection Readiness. The person performing the check must provide a signed form for each unit. Provide complete signed and dated for each unit prior to calling for final inspection.

- Unit installation: (per details on plans)
 - The manufacturer's service and operating clearances have been provided and if free of conduit, piping, ductwork, etc.
 - WH has T&P piped off per code.
 - Unions installed on hot and cold-water connections above WH for future maintenance.
 - Drain pan installed,
 - WH sits on Unistrut to lift up in drain pan.
 - Drain pan drain line installed.
 - Expansion tank installed, wall mounted or suspended. (not on floor)
 - Check valve, balancing valves, ball valves, and strainers all installed per detail.
 - HW, CW, HWR all piped according to detail.
 - Aquastat installed.
 - Vacuum breaker installed.
 - Housekeeping pad installed when required.
 - Perforated straps are not allowed for supporting of piping or equipment.
- Piping:
 - Insulated with PVC jacketing per specifications.
 - Ends of insulation covered with mastic.
 - The insulation is sealed per specification and does not have gaps.
 - All piping labeled, with correct label spacing.
 - All piping to be installed in a manner to make changeout of WH easy.
 - Valve Tags installed
- Gas WH:
 - Gas pipe with sufficient straight piece to allow water heater or boiler to function properly.
 - Dirt leg installed with cap and not touching ground.
 - Combustion Air vent piping installed per manufacturer installation instructions.
 - For intake length including bends
 - For exhaust length including bends
 - Termination location, including distance from obstructions and parapets.
 - Provide Acid Neutralization Trap for all condensing gas water heaters.

Signature of Person Completing Readiness Checklist. _____ Date _____



Outstanding Items Final Punch Inspection Contractor Readiness Checklist

THE FOLLOWING ITEMS ARE REQUIRED TO BE ADDRESSED AND SIGNED OFF IN WRITING BY CONTRACTOR FOR EACH UNIT OR ROOM AS INDICATED BY INDIVIDUAL ITEMS BELOW. THESE ITEMS MUST BE COMPLETED AND SUBMITTED WITH ANY DEFICIENCIES CORRECT PRIOR TO REQUESTING FINAL MEP INSPECTION.

GENERAL ITEMS:

COMPLETED () / INITIALS

- / _____ ITEM NO.1: ALL MECHANICAL UNITS: PROVIDE CONTRACTOR READINESS CHECKLIST (START-UP FORMS),
- MECHANICAL CONTRACTOR - START-UP REPORTS
 - MANUFACTURER START-UP FORM (WHEN REQUIRED)
 - MECHANICAL START-UP FORM
 - CONTROLS START-UP FORM
 - TEST-BALANCE WITH ALL DEFICIENCIES ADDRESSED.
 - COMMISSIONING FOR ALL MECHANICAL UNITS AS LISTED IN SPECIFICATION. SCHEDULE OF VALUE LINE ITEM WILL NOT BE PAID UNTIL ALL FORMS FOR ALL EQUIPMENT HAVE BEEN COMPLETED, SUBMITTED AND REVIEWED. PARTIAL PAYMENT WILL NOT BE PROVIDED. SPECIFICATION SECTION 20 00 00.
- / _____ ITEM NO.2: PROVIDE TEST AND BALANCE REPORT WITH ALL DEFICIENCIES ADDRESSED AND WITH DISCHARGE AIR TEMPS IN COOLING MODE PER SPECIFICATIONS.
- / _____ ITEM NO.3: CONFIRM ACCESS DOORS ARE PROVIDED FOR ALL FIRE/SMOKE DAMPERS AND OTHER REQUIRED LOCATIONS, PER DETAILS, SPECIFICATIONS FOR ACCESS TO REQUIRED COMPONENTS. ENSURE ACCESS DOORS ARE PROVIDED IN DUCTWORK AS DESCRIBED IN RTU AND AHU DETAILS AT FIRST 90° TURN FOR RTU AND BOTH SUPPLY AND RETURN OF AHU. REFERENCE SPECIFICATION FOR PROPER SIZE AND SPACING.

/ _____ ITEM NO.4: CONFIRM ALL THERMOSTATS CALIBRATED AND ADJUSTED TO + OR – 1 DEGREE ACCURACY. PROVIDE SIGNED FORM FOR ALL SENSORS.

/ _____ ITEM NO.5: CHECK DISCHARGE AIR TEMPERATURE OFF OF ALL COOLING UNITS. (INCLUDE DISCHARGE AIR IN COOLING FOR EACH STAGE OF COOLING, MUST BE 56 DEGREES OR COOLER, REFERENCE START-UP FORMS)

/ _____ ITEM NO.6: CHECK DISCHARGE AIR TEMPERATURE AND HUMIDITY OFF OF ALL MAKEUP/OUTSIDE AIR UNITS. (MUST BE 53 DEGREES OR COOLER OFF COIL) WHEN MAU'S ARE PRESENT ON JOB.

/ _____ ITEM NO.7: LIGHTING CONTROL TEST DOCUMENTATION : PROVIDE FACTORY START-UP AND PROGRAMMING OF 'NIGHT' LIGHTING CONTROLS. PROVIDE DOCUMENTATION THAT THIS FACTORY PROGRAMMING HAS OCCURRED.

/ _____ ITEM NO.8: SURGE PROTECTION TEST DOCUMENTATION: PROVIDE DOCUMENTATION THAT MANUFACTURER ONSITE TESTING HAS BEEN COMPLETED FOR SURGE PROTECTION.

/ _____ ITEM NO.9: TRANSFORMER TEST DOCUMENTATION: PROVIDE DOCUMENTATION FOR TRANSFORMERS THAT MANUFACTURER HAS VERIFIED CONNECTIONS AND TESTED USB PORT FUNCTION. WHEN TRANSFORMERS PRESENT ON JOB.

/ _____ ITEM NO.10: VERIFY THAT MECHANICAL CONTROL SYSTEM IS COMPLETE.

- ENSURE THAT ACCESS TO CONTROLS IS CONNECTED AND OPERATIONAL.
- OWNER SCHEDULE HAS BEEN INPUT.
- ALL SEQUENCES OF OPERATION FUNCTION PROPERLY
- ALL CONTROL START-UP FORMS COMPLETED AND SUBMITTED.
- ENGINEER WILL REQUIRE ACCESS TO CONTROL SYSTEM DURING FINAL VISIT. PROVIDE ACCESS CODES AND PASSWORDS TO ENGINEER.

/ _____ ITEM NO.11: ELECTRICAL CERTIFICATE OF COMPLETION PER SPECIFICATIONS, INCLUDING ALL GROUNDING TESTING, MEGGER READINGS REQUIRED BY SPECIFICATIONS.

/_____ ITEM NO.12: CONTRACTOR READINESS FORMS COMPLETE FOR EACH PIECE OF EQUIPMENT: (ATTACHED)

- MECHANICAL UNITS – AHU, RTU, MAU

- WATER HEATERS

/_____ ITEM NO.13: AS-BUILTS PROVIDED.

/_____ ITEM NO.14: O&M'S PROVIDED.

/_____ ITEM NO.14: ALL PREVIOUS ITEMS IN ALL PREVIOUS REPORTS THAT HAVE NOT BEEN FIXED ARE STILL CONSIDERED OUTSTAND AND SHOULD BE FIXED WITH PHOTOGRAPHIC PROOF PROVIDED TO OWNER/ENGINEER/ARCHITECT, PRIOR TO GETTING PAYMENT FOR SUBSTANCIAL COMPLETEION.

THE CONTRACTOR SHALL RESPOND IN WRITING THAT ALL DEFICIENCIES HAVE BEEN CORRECTED. SEND RESPONSE BACK TO ARCHITECT.

Sign before requesting Final Inspection

Signature of Person Completing Readiness Checklist. _____ Date_____

SECTION 26 05 10 - SCHEDULE OF VALUES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The Contractor shall breakdown the final Schedule of Values to be used for pay application into the following minimum categories.
- B. **ALL CATEGORIES SHALL HAVE APPROPRIATE MATERIAL AND LABOR BREAKDOWN.**
- C. Final Payment will **NOT** be made until all required documentation is submitted with ALL deficiencies addressed.
- D. Definitions:
 - 1. Service: Conduit for utility company and conduit and wire from utility transformer to main switchboard.
 - 2. Feeders: Include all conduit and wire serving transformers and panelboards.
 - 3. Branch Circuit: Any circuit from a panelboard to a utilization device.
 - 4. Gear: Main switchboard, panelboards, transformers, disconnects, etc.
 - 5. Site conduit voice/data.

1.02 SCHEDULE OF VALUES

- A. Mobilization
- B. Utility Company Fees
- C. Service - Wiring and Conduit
- D. Site Lighting - Wiring and Conduit
- E. Gear
- F. Site Lighting Fixtures
- G. Interior Lighting Fixtures
- H. Branch Circuit - Wiring and Conduit
- I. Feeders - Wiring and Conduit
- J. Devices (switches and receptacles)
- K. Fire Alarm System
- L. Sound Systems
- M. Testing/Labeling of Equipment

- N. Factory Lighting Controls Start-up Documentation - (\$10,000 minimum)
- O. Factory Transformer/SPD Start-up Documentation - (\$10,000 minimum)
- P. Gear Coordination Study - (\$10,000 minimum)
- Q. Wire Megger Testing Reports Documentation - (\$10,000 minimum)
- R. Record Drawings and O&M Manuals (\$1500 minimum)
- S. Signed and Completed - Certificate of Completion Documentation - (\$10,000 minimum)

END OF SECTION

SECTION 26 05 19 - WIRE AND CABLE

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Provide a complete system of conductors in raceway systems as shown on the drawings and hereinafter specified. Route all wire through an approved raceway unless otherwise indicated, regardless of voltage application.
- B. Provide 200% neutral conductors only to panels with 200% neutral specified on plans. Reference Panel Schedules.
- C. **Provide individual neutrals for each circuit, no shared neutrals allowed.**
- D. **No de-rating of neutrals allowed.**

1.02 STANDARDS

- A. Provide conductors in accordance with the applicable sections of UL and IPCEA Standards.

1.03 SUBMITTALS

- A. Furnish Engineer shop submittals for each type of wire and cable.
- B. Provide shop submittals which includes the following information:
 - 1. Insulation type.
 - 2. Insulation temperature rating.
 - 3. Manufacturer

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Wire and Cables: (600 Volts)
 - 1. Provide copper wire and copper ground conductors **only**. Conductors shown on plans are thusly sized. **No aluminum conductors** will be allowed unless specifically noted.
 - a. Minimum wire size for branch circuits shall be #12, however, #14 may be used for motor control circuits where specified on the drawings.
 - b. All conductors #12 and smaller shall be solid and #10 and larger shall be stranded.
 - 2. Provide copper conductors of annealed, 98 percent conductivity soft drawn copper. Provide stranded conductors for control circuits.

- B. **Metal clad cable shall not be acceptable for lighting circuits except from junction box to light fixture, maximum 6 feet in length.**
1. **Type MC-PCS combination power/dimming metal clad cable is acceptable for use with the above limitation.**
- C. **Metal-clad cable shall not be acceptable for receptacles.**
- D. Roof mounted maintenance receptacles shall have circuit routed in "seal tight" or "carflex". Must be used for all locations on roof, routing in RTU's and on roof.
- E. Insulation: (600 Volts)
1. Provide all conductor insulation types rated for wet and dry locations and approved by the National Electrical Code for the particular application. Provide all wire and cable with the following (or better) insulation classes:
- a. All feeders and branch circuits are to be dual-rated Type THHN/THWN copper conductors.
- b. Insulation rated for operation at 600 volts.
- c. In areas where the temperature will exceed 167°F, provide wire rated 105°C. minimum and a type approved by the local code. Include any wiring within three feet (3') horizontally or ten feet (10') above any heating appliance.
2. Color code in accordance with the wiring diagrams furnished with equipment. All wiring for control systems to be installed in conjunction with mechanical and/or miscellaneous equipment. Color code by line or phase all branch circuit wiring including circuits to motors and feeders as follows: Wire No. 10 and smaller shall be factory color coded. Wire No. 8 and larger may be color coded by color taping within six inches (6") of exposed ends. **Color coding for each nominal voltage shall be consistent throughout building from point of origination to the termination point including tap conductors to luminaire. Mixing of colors between voltages will not be allowed.**
- 120/240 Volts
- Phase A - Red
Phase B – Orange
Phase C – Black
Neutral - White
Ground - Green
(Orange is High Leg)
- F. Wire and Cable: (50 volts or less)
1. Provide copper wire, minimum size #18 AWG for controls, #18 AWG minimum for fire alarm and #20 AWG minimum for communications. All wire and cable shall be solid. Stranded conductors are not acceptable.
2. All conductors shall be routed in conduit or shall have an insulation approved for plenum installation, unless otherwise noted.
- G. ROMEX not allowed.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Unless otherwise indicated, wiring size noted on the drawings extends for the entire length of a circuit. Install wire in raceways in strict conformance with the manufacturer's recommendations. Use a UL approved wire-pulling lubricant. Strip insulation so as to avoid nicking of wire.
- B. Wire Connections and Devices:
 - 1. Provide all terminating fittings, connectors, etc., of a type suitable for the specific cable. Make all fittings up tight. Make up all terminations in strict conformance with manufacturer's recommendations using special washers, nuts, etc., as required.
 - 2. Connect No. 8 and larger wire to panels and apparatus with properly sized, solderless, or compression lugs or connectors.
 - 3. Join No. 10 and smaller wire by twisting tight and applying UL listed twist-on connectors.
 - 4. Leave at least an eight-inch (8") loop of wire for ends at each outlet box for the installation of fixtures or devices.
- C. Flashover or insulation value of joints shall equal that of the conductor. Provide connectors rated at 600 volts for general use and 1000 volts for use within fixtures.
- D. Grouping shall be 3 Hots and 3 Neutrals or 6 Hots max. Derating shall be based on the 90-degree chart of NEC 310-16 and table 310.15 (B)(2)(2).
- E. Where the distance between the supplying panel and the first branch circuit receptacle, light fixture or equipment is more than 100 feet, upsize wire to allow for maximum of 3% voltage drop for actual routing of conduit to device.
- F. Wiring for emergency systems shall be kept entirely independent of all other wiring and equipment as required by Article 700 of the NEC.
- G. Mechanically protect conductors by installing in raceways. Do not install the conductors until raceway system is complete and properly cleaned. Use an approved wire-pulling compound when pulling conductors. Wiring pulling compound shall be listed and as recommended by the conductor manufacturer. Do not bend any conductor either permanently or temporarily during installation to radii less than four times the outer diameter of the insulated conductors. Do not exceed manufacturer's recommended values for maximum pulling tension.
- H. Pull conductors simultaneously where more than one conductor is being installed in the same raceway.
- I. Use pulling means including fish tape, cable, rope, and basket weave wire/cable grips which will not damage cables or raceway.
- J. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standard 486A.
- K. Neatly and securely bundle all conductors in enclosures using nylon straps with a locking hub.

- L. At least 6 inches (measured from the finished surface) of each conductor shall extend outside a box's opening.
- M. Conductors shall not be routed from panel to equipment above the roof deck. All conductors for roof mounted equipment shall be routed below roof deck to equipment roof opening or adjacent roof penetration.
- N. For buildings with a smoke control system, per IFC 909.12.2, all wiring for all components of the smoke control system, regardless of voltage, shall be installed in a continuous raceway.

3.02 SPLICES AND TERMINATIONS

- A. Splices shall be kept to a minimum.
- B. Splices shall be made in junction and/or pull boxes.
 - 1. Splices in conduit fittings (i.e., conduit bodies), and in panelboards are not acceptable.
- C. All materials shall prevent corrosion or electrolysis between dissimilar metals.
- D. Use terminal blocks within a junction box for all splices of No. 6 and larger conductors.
- E. Use mechanical, crimp or compression type connectors for terminations of stranded conductors.

3.03 CONDUCTOR SIZING

- A. Install conductor size required by the more stringent requirements of the drawings or specifications.
- B. Install No. 10 AWG conductors the entire length of the circuit for single-phase, 120-volt, 20-ampere branch circuits for which the distance from panelboard to the first outlet is more than 100 feet.
- C. Install No. 10 AWG conductors the entire length of the circuit for single-phase 277 volt, 20-ampere branch circuits for which the distance from panelboard to the first outlet is more than 200 feet.
- D. General use circuit numbers may be changed. Equipment circuits have numbering to balance loads. This contractor is responsible for maintaining a balanced load and recording the actual circuit numbers.
- E. Comply with ampacity adjustment factors as required by the NEC Article 310-16.

3.04 TESTING

- A. Prior to energizing feeders, perform insulation resistance tests at 500 Volts D.C. for 30 seconds on each cable with respect to ground and adjacent cables. Maintain the following log for feeder tests:

FEEDER DESCRIPTION: _____

TESTER'S NAME: _____

TEST INSTRUMENT SERIAL #: _____

TEST DATE: _____

RESISTANCE: _____

A-B

A-C

A-G

B-C

B-G

C-G

- B. Test all circuits for proper neutral connections.
- C. Upon completion of all testing, prepare a detailed report of all voltage and insulation resistance measurements. Deliver report to Engineer with request for final inspection.

END OF SECTION

SECTION 26 05 26 – GROUNDING AND BONDING

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Provide a complete grounding system in strict accordance with Article 250 of the National Electrical Code and as hereinafter specified and shown on the Drawings.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Provide copper clad 5/8" x 8 ft. - 0" long ground rods, appurtenances, bonding plates, clamps, connectors and grounding conductors as required. Furnish rods to which the copper cladding is permanently and inseparably bonded to a high strength steel core.

2.02 CONNECTORS

- A. Provide exothermic weld type ground connections for concealed, underground, and concrete encased ground connections.
- B. Exposed connections may be made with copper or bronze bolted or compression lugs.

2.03 INTER-SYSTEM GROUNDING BUS-BAR (communications)

- A. Provide surface mounted terminal blocks sufficient to except 20 individual conductors of sizes 14 AWG thru 4 AWG.

2.04 2.04 CONDUCTORS

- A. Furnish copper conductors.
- B. Furnish 600-volt, insulated conductors for equipment grounding.
- C. Size the system grounding electrode conductors to comply with NEC section and table 250-66, unless shown larger.
- D. Size the main and separately derived system bonding jumpers to comply with NEC section 250-28 (D).
- E. Size equipment grounding conductors to comply with NEC section and table 250-122, unless shown larger.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Properly ground all service equipment conduit systems, supports, cabinets, equipment, motor frames, fixtures, etc., and the grounded circuit conductor in accordance with the latest issue of the National Electrical Code. Provide all bonding jumpers and wire, grounding bushings, clamps, etc., as required for complete grounding. Route ground conductors to provide the shortest and most

direct path to the ground electrode system. Bond conduit if made of current conducting material. All ground connections shall have clean contact surfaces. Bond the service equipment to a grounding electrode as shown on the Drawings.

- B. Provide a grounding type bushing for all feeder and branch circuit conduits which do not have a grounding conductor and individually bond this raceway to the enclosure's ground bus or lug.
- C. Provide a grounding type bushing on the end of each isolated section of metal conduit and bond the conduit to the equipment grounding conductor, or using a conductor of the same size, bond directly to the equipment ground buss of the equipment at the end of the run.
- D. Make single or dual connections to ground rods, plates, and other buried connections by the exothermic process (Cadweld) or Burndy Hyground TM Compression Systems and "hammer tested" to ensure that a good bond has been made. Alternatively, all below grade compression grounding systems must meet all UL467, CSA, IEEE837 test requirements and conform to the National Electrical Code Standards. The material at the connectors shall be pure wrought copper extrusions, rod and seamless tubing and be identical material to the conductor. Connectors must be of heavy-duty design and be of range taking design to accept conductor ranges of #6 solid to 500 Kcmil plus 5/8" ground rods. Compression connectors need to be compressed with system engineered tooling which makes a circumferential or round crimp. Hex crimp is not acceptable due to sharp flashes and spurs that may occur. Each connector must be clearly marked with catalog number, conductor size and installation die information. Inspection ports must be provided on lug terminations and splices. The system must emboss all the appropriate die index numbers on all connectors after completion of the crimp. Connectors must be prefilled with penetrox copper type oxidation inhibitor and be individually sealed in clear polyethylene sheet to keep out dirt and contamination.
- E. Drive grounding electrodes as required. Where rock is encountered, grounding plates of copper, 1/4-in. x 24-in. x 24-in may be used in lieu of grounding rods. Plates must be installed at 36" minimum below finished grade.
- F. Connect grounding electrode conductor to building steel and metallic waterline per NEC 250-81. Allow a minimum of 25 feet of grounding conductor in foundation footing and make 3 connections to Rebar. Connections shall utilize an acceptable compression method with connectors listed for contact with respective metal types.
- G. Provide a grounding terminal pad in all panelboards, switchboards, and other electrical equipment.
- H. Directly ground to the work piece welding machines used in construction. The use of the building or equipment steel or conduits of any kind as a common ground point is not allowed under any conditions. Contractor is responsible for any electrical pieces of equipment damaged by not using the welder grounding method described above.
- I. Provide a green insulated grounding conductor in all conduit serving receptacles and/or equipment. Refer to panelboard schedules for sizing.
- J. Ground all receptacles to outlet box with a conductor.
- K. Flexible conduit will not be allowed as a grounding means.
- L. Install metallic fittings on clean contact surfaces to ensure electrical conductivity.
- M. Tighten connectors, terminals, screws and bolts, in accordance with manufacturer's published torque tightening values or comply with torque tightening values specified in UL 486A to assure permanent and effective grounding.

- N. Apply a corrosion-resistant finish to places where factory applied protective coatings have been damaged.
- O. Protect all exposed, grounding electrode conductors with Schedule 40 PVC nonmetallic conduit.
 - 1. Grounding electrode conductors shall not be protected with metallic materials.

3.02 GROUNDING ELECTRODE SYSTEM

- A. At each building's service or disconnecting means, install a grounding electrode system which includes:
 - 1. A concrete encased electrode connected to the concrete reinforcing bars and
 - 2. The building structural steel and
 - 3. The building's metal underground (10 ft.) water pipe.
 - a. This connection must be within the first 5 ft. of the water pipe's entrance into the building. Water piping cannot be the sole ground and must be supplemented.
 - 4. Other electrodes such as a rod, plate or ring may be used to supplement but cannot be used as a substitute.
- B. At each grounded separately derived system, install a grounding electrode conductor to connect the grounded (XO-neutral) conductor to:
 - 1. The nearest one of the following electrodes:
 - a. An effectively grounded structural steel member or
 - b. An effectively grounded metal underground (10 ft.) water pipe.
 - 1) This connection must be within the first 5 ft. of the water pipe's entrance into the building.
 - 2. If neither of these is available, install a 3/0, copper, common grounding electrode conductor from the building's service or disconnecting means. Connect taps from this common grounding electrode conductor to the separately derived system's grounded (XO-neutral) conductor.

3.03 SYSTEM BONDING

A. SERVICES

- 1. Install a main bonding conductor between the service ground bus and the grounded (neutral) bus-bar.

B. SEPARATELY DERIVED SYSTEMS

- 1. Install a bonding jumper between the equipment ground bus and the separately derived electrical system's (transformer, UPS, central battery/inverter or generator) grounded (XO-neutral) bus.

3.04 ADDITIONAL BONDING

- A. Install 3/0 AWG bonding jumpers around all structural metal expansion joints.
- B. Each building's interior metal water piping system which does not qualify to be used as a grounding electrode shall be bonded to the building's service or disconnecting means.
- C. Bond the grounded (XO-neutral) conductor of each separately derived system to the nearest available point of the interior metal water piping system(s).
 - 1. When the structural steel is being used as the grounding electrode for the separately derived system, the interior metal water piping system(s) may be bonded to the structural steel.
- D. Install bonding jumpers around raceway expansion joints.
- E. Install bonding jumpers around insulated water pipe joints.
- F. Install a bonding jumper between all grounding electrodes used for communications, radio and television or antenna systems and the building's grounding electrode system.

3.05 COMMUNICATION GROUNDING

- A. Provide a surface mounted, inter-system grounding bus-bar at the service equipment or a separate building's disconnecting equipment and in each communications room.
- B. At the service or separate building's disconnecting means, provide an insulated 6 AWG, stranded conductor to connect the inter-system grounding bus-bar to the equipment ground bus.
- C. At communications rooms, provide an insulated 6 AWG, stranded conductor to connect the inter-system grounding bus-bar to the building's structural steel.

3.06 EQUIPMENT GROUND

- A. Raceways shall not be used as the sole equipment ground.
- B. Bond the equipment grounding conductors to all boxes and enclosures.
- C. Each receptacle shall be bonded to its respective device box. The connection shall be made by means of a bonding jumper between the device and the box. Where the receptacle mounting yoke is designed and listed for the purpose of grounding, the bonding jumper may be omitted. This does not substitute for the need of grounding the outlet box.
- D. Each isolated ground receptacle shall have an isolated ground conductor installed complete from receptacle to the isolated ground bus in the panelboard. No other grounding connections shall be made to these receptacles, specifically connections to the device box or raceway system.

3.07 POOL GROUNDING/BONDING

- A. Electrical Contractor shall coordinate all equipment grounding, equipotential grounding/bonding, bonding, and all connection requirements to pool equipment, building steel, concrete rebar, any other metal components in pool area with pool equipment installer and pool installer. Provide connections and bonding/grounding to all electrical equipment in and around pool per NEC article 680. Provide pictures of grounding/bonding wire prior to concrete or pool concrete being poured, for records.

3.08 TESTING

- A. Following completion of installation, test system ground for continuity and test resistance to ground by "fall of potential" method and all feeders or sub-feeders with appropriate meggers, or other approved instruments and methods, to determine ground and insulation resistance values.
- B. Submit logs of values obtained, nameplate data of instruments used and instrument calibration data prior to final inspection. Instruments used are subject to acceptance.

END OF SECTION

SECTION 26 05 29 – HANGER & SUPPORTING DEVICES

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Provide all required supporting devices, including but not limited to channels hangers, brackets, fittings, clamps, hardware, anchor bolts, rods, electrical accessories, etc., for conduit and equipment.

1.02 STANDARDS

- A. Conform with the latest requirements of the NEMA and The National Electric Code.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Support Channel: Hot-dipped galvanized steel, sized for load, minimum size 12 gauge, 1-5/8 wide by 13/16 deep. Furnish fasteners sufficiently sized to carry load imposed.
- B. Hardware: Corrosion Resistant (Hot-dipped galvanized all steel components)
- C. Support Wires (16 Ga. Minimum) and Tie Wires (22 Ga. Minimum) or as required by UL listed assemblies: Galvanized Steel
- D. Coatings: All steel components shall be hot-dipped galvanized.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Perforated iron straps are not permitted for supporting conduits. Conduits run between the webs of bar joists may use galvanized tie wire for securing the conduits. Cut excess wire and bend ends to prevent sharp ends.
- B. Support horizontal and vertical conduit runs by one-hole straps, clamp-backs or other acceptable devices and suitable bolts. All conduits shall be secured to structure with supporting devices dedicated for the electrical system and/or conduits for systems furnished under the Electrical Contractor responsibilities. When two (2) or more conduits are run parallel, they may be supported on trapeze hangers, equal to the Modern Co. Other hangers shall be constructed with rods and hanger adjusters of adequate size to carry the loads imposed.
- C. All conduits shall be supported a maximum of ten feet (10') on center. Also, support conduits within twelve inches (12") of any bends, outlet boxes, wall penetrations or joints in pipe. All conduits shall be secured to structure. Lighting fixture whips may not be secured to ceiling tie wires. Vertical risers shall be supported by approved riser clamps or supports installed at the respective floor lines.
- D. Conduits routed below bar joists shall utilize acceptable clamps.

- E. Fasten hanger rods, conduit clamps and outlet and junction boxes to building structure using precast insert system, expansion anchors, preset inserts, or beam clamps. Do not use spring steel clips and clamps. Submit method of attachment for review prior to commencing work.
- F. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheetmetal screws in sheetmetal studs; and wood screws in wood construction.
- G. Do not fasten support wires to piping, ductwork, mechanical equipment, or conduit.
- H. **Do not fasten conduit or junction boxes to ceiling grid wire. All conduit must be independently supported.**
- I. Support recessed fluorescent light fixtures with support wire at all four corners as required by roof/ceiling assembly. If roof/ceiling assembly does not require supports at each corner, support fixtures with minimum of two support wires at diagonally opposite corners. Spray paint ends of fixture support wires orange.
- J. Conduits, except as approved by NEC, shall not be used to support low voltage cables.
- K. Support all piping on roof with pipe stands/roller equal to MIRO Industries Model 4-RAH-PC or Portable Pipe Hangers, Inc., Type PP10 with roller for conduit 2-1/2" and smaller. For conduit over 2-1/2", up to and including 4" use MIRO Industries Model 6-RAH-PC or Portable Pipe Hangers, Inc. (PPH) Type PS-1-2. All conduit stands to sit on walk board (coordinate type and methods of support with Roofing Contractor). Provide minimum pipe height above roof deck as required by jurisdiction having authority (at least 3-1/2"). Provide supports for piping under 2" at six feet on center. Provide supports for conduit 2" and over at eight feet on center.
- L. Provide all angles, unistrut supports and threaded rods under any structural elements or mechanical equipment where required for proper placement and support of light fixtures and/or conduits.
- M. Supports and hangers shall be installed to permit free expansion and contraction in the raceway systems. Where necessary to control expansion and contraction, the raceways shall be guided and firmly anchored. Anchors shall be approved by the Engineer and shall be designed for equal effectiveness for both longitudinal and transverse thrust. No conduit shall be self-supporting, nor shall it be supported from equipment connections. Transmission of vibrations, noise, etc., shall be considered and any special suspension with vibration dampers to minimize transmission shall be used where necessary.
- N. Where ducts interfere with the proper location of hangers, furnish and install trapeze hangers. Trapeze hangers may be used to support groups of conduit run in parallel.
- O. Install metal framing to support wall mounted equipment and wall or ceiling mounted raceways.
- P. Install expansion bolts to attach framing to concrete. Space bolts a maximum of 24 inches on center, with not less than two bolts per piece of framing.
- Q. Touch up all scratches or cuts on steel components with an approved zinc chromate or a 90 percent zinc paint.

END OF SECTION

SECTION 26 05 33 - RACEWAYS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Provide a complete conduit system as shown on the drawings and as hereinafter specified.

1.02 STANDARDS

- A. Conform with the latest requirements of the NEMA, the National Electrical Code, and be UL listed.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Rigid Metal Conduit (RMC): Hot-dip galvanized, threadable steel raceway, galvanized after fabrication. Fittings shall be malleable iron, either cadmium plated or hot-dip galvanized.
- B. Intermediate Metal Conduit (IMC): Conduit shall be similar to rigid steel conduit except thinner wall. Fittings shall be malleable iron, either cadmium plated or hot-dip galvanized.
- C. Electrical Metallic Tubing (EMT): EMT shall be made of hot-dip galvanized strip steel. Fittings shall be steel or die cast compression or set screw type.
- D. PVC - Schedule 40 and Schedule 80 polyvinyl chloride conduit (PVC Duct) shall be UL rated. Conduit fittings and cement shall be produced by the same manufacturer and approved for such use.
- E. Flexible Metal Conduit (FMC): Spirally wound continuously interlocked zinc coated strip steel. Fittings shall be steel or die cast zinc, either screw-in or squeeze type.
- F. Flexible Conduit (LFMC): Liquid-tight (vibration and/or wet areas) fabricate from continuous lengths of spirally wound galvanized steel strip interlocked with a gray polyvinyl chloride cover extruded over the core to make the conduit liquid tight, oil proof and bendable to a small radius. Fittings shall be compression type, steel or die cast zinc, with insulated throat.
- G. Metal-Clad Cable (MC): Galvanized interlocking steel armor. 600-volt, type THHN/THWN, integrally colored insulation. Size #12 AWG or #10 AWG, copper conductors. Fittings shall be listed for MC usage and include anti-short bushings. Reference Section 3.03 for acceptable uses.
- H. Metal Wire-ways.
 - 1. Furnish with wire retainers on not less than 12-inch centers. All screws installed towards the inside shall be protected to prevent possible wire insulation damage.
 - 2. The finish shall be the manufacturers' standard color and shall consist of not less than two coats of enamel over a rust-inhibiting prime coat.
- I. Surface Metal Raceway (2000 series).
 - 1. Surface metal raceway shall consist of a single compartment base, blank cover, and appropriate fittings to complete the installation per the electrical drawings.

2. The base and cover shall be manufactured of steel and finished with a white color.
 3. Approximately $\frac{3}{4}$ " deep, 1 $\frac{1}{4}$ " high and 5' sections.
- J. Non-Metallic Multi-outlet Assemblies (5400 series).
1. Surface raceway system shall consist of a dual compartment raceway base, twin cover, appropriate fittings, outlets and device mounting plates necessary for a complete installation.
 2. Duplex receptacles and data outlets ("activate connectivity inserts") mounted at 24" centers or as noted on plans. Connect adjacent receptacles on alternate circuits.
 3. Approximately 1 $\frac{3}{4}$ " deep, 5 $\frac{1}{4}$ " high and 8' sections with equal compartments.
 4. The finish shall be white color and shall consist of not less than one coat of enamel over a prime coat.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

- A. Raceway and cable usage and installation shall conform to the appropriate article of the National Electrical Code (NEC), as a minimum.
- B. Do not install conduit that is crushed or deformed in any way.
- C. Provide a nonmetallic (nylon, polypropylene, or approved equal) drag line of suitable strength in spare conduits and telephone conduits. Tightly plug spare conduits at both ends.
- D. Do not pull wire into conduit system until the conduit system is complete in all details; in the case of concealed work, until all rough plastering or masonry has been completed.
- E. No wiring systems of any type shall be installed in ducts used to transport dust, loose stock, or flammable vapors.
- F. No wiring system of any type shall be installed in any shaft containing ducts used for vapor removal or for ventilation of commercial-type cooking equipment.
- G. Fasten and support the wiring method employed to the permanent structure using listed straps with corrosion resistant hangers and fasteners.
- H. Ceiling system wires or lay-in type ceiling grid components shall not be used as a means of support.
 1. Independent support wires and associated fittings which are installed in addition to the ceiling system support wires, shall be permitted: (300.11.A)
 2. Independent wires within the cavity of a fire-rated floor-ceiling or roof-ceiling assembly shall be distinguishable by color. (300.11.A.1)
 3. Independent support wires that provide support for device boxes shall be secured at both ends. (300.11.A).

- I. Bends shall be made with factory elbows or field bent. Field bends shall be made using equipment designed for the particular raceway material and size. Bends shall be free from dents or flattening.
- J. Conduit bodies may be used in lieu of conduit elbows where covers will be accessible, and ease of installation and appearance warrants their use.
- K. Install expansion-deflection fittings where raceways cross structural expansion joints or where required to compensate for soil deflection or thermal expansion and contraction. Install bonding jumpers across expansion-deflection fittings in metal raceway systems.
- L. Openings through fire-resistant-rated or sound-resistant-rated walls, partitions, floors or ceilings shall be fire-stopped by installing raceways or cables through sleeves set through the walls, partitions, floors or ceilings and fire-sealing all openings and voids around the sleeves, raceways and cables.
- M. Do not drill or pierce structural steel members under any circumstances without the Engineer's specific approval.
- N. Minimize roof penetrations by routing conduit through the equipment roof opening. If roof penetration is necessary, coordinate with the Architectural Specifications and penetrate as directly below the equipment disconnect or wiring connection point as possible. Do not use flexible conduit in a pitch pan.
- O. Conduit shall not be routed from panel to equipment above the roof deck. All conduit for roof mounted equipment shall be routed below roof deck to equipment roof opening or adjacent roof penetration.
- P. Arrange all conduits to drain away from the building.
- Q. Perform all necessary excavation and backfilling. Tamp backfill in six-inch (6") layers to original grade, moistening as required for proper compaction. All backfilling shall be free from harmful materials. Provide shoring, bracing, and de-watering as necessary. Remove all excess and materials not suitable for backfill from the site. Provide barricades to prevent endangering the public. Provide warning beacon lighting at night to adequately mark all excavations.
- R. A tracer tape wire shall be installed in all trenches which do not contain conductive conductors within them. This will include future use raceways, optical fiber, etc.
- S. Raceway systems shall be complete before installing conductors.
- T. The interior of all raceways shall be cleaned before installing conductors.
- U. Terminate future use raceways with a capped coupling within an accessible area.
- V. Unless otherwise noted, all conduits are expected to be concealed inside walls or above ceiling. In areas with open ceilings that require exposed conduits, all conduits shall be routed perpendicular or parallel to building lines with final routing approved by the architect or engineer prior to installation.
- W. In locations where Type MC cable is approved for installation in Specification 26 05 19 and in this specification, it shall be installed in a neat and workmanlike manner. Cable shall not cross other cable or have excess slack. Cable that is installed vertically, must be plumb with the vertical framing of the structure.
- X. Bundling of cable is limited to three cables for each support ring.

- Y. Type MC cable may be only supported by fasteners or clamps that are approved and UL tested for cable support.
- Z. For buildings with a smoke control system, per IFC 909.12.2, all wiring for all components of the smoke control system, regardless of voltage, shall be installed in a continuous raceway.

3.02 INSTALLATION BELOW GRADE

- A. Minimum size raceway is 3/4 inch.
- B. Provide rigid galvanized steel conduit or PVC where conduits are installed in concrete floor slab 3/4" maximum. Maintain proper concrete coverage as directed by structural engineer. PVC conduit shall not penetrate slab above finished grade.
- C. Provide rigid galvanized steel or PVC conduit where conduits are installed below grade.
- D. Swab clean all conduits before cable installation. Waterproof all conduit joints after cable installation.
- E. Provide conduit wall sleeves for all conduits penetrating walls, grade beams, etc. and other locations shown on the Drawings.
- F. Where required to bend PVC ducts to satisfy indicated routing, preform ducts to allow ends of duct sections to be in a straight alignment. Accomplish preforming of ducts by utilizing proper duct heater units.
- G. Perform all necessary excavation and backfilling for proper installation of work. Take precautions not to excavate below depth required. Backfill trenches with sand, 3" below conduits and 3" above. Tamp remainder of backfill in six-inch (6") layers to original grade, moistening as required for proper compaction. All backfilling shall be free from harmful materials. In areas to be paved, compact to density to receive pavement. Where pavement is broken for the installation of conduit, repair to original condition. Provide shoring, bracing, and de-watering, if necessary, for installation of work. Remove from site all materials encountered which are not suitable for backfill.
- H. When and if damage is caused to underground utility lines or structures, above ground utility lines or structures, or other purposeful surface conditions, either on or off the right-of-way, make immediate temporary repairs. At the first opportunity, make permanent repairs which are acceptable to the Owner. All such repairs shall be made at the Contractor's expense.
- I. Where necessary, provide barricades around open excavations to prevent endangering the public. Provide warning beacon lighting at night to adequately mark all excavations.
- J. Where conduits embedded in concrete floor or roof deck cross expansion joints, they shall be joined together using O.Z. Gedney type DX expansion fittings and bonding jumpers. Straight runs of conduit over 150' long shall have O.Z. Gedney Type AX expansion fittings installed to minimize movement. Fittings shall be installed at a maximum of 150' on center.
- K. Where horizontal runs of conduit transition to vertical and continue above finished grade or finished floor; the transition shall be made with a 90-degree long radius sweep. The sweep may be PVC (2" and smaller) and shall be RMC (2-1/2" and larger). No PVC conduit will be allowed above finished grade or finished floor except where Schedule 80 PVC is specifically required by the electric utility for service conduits only.
- L. **CONDUITS RUN BELOW FINISHED FLOOR SHALL NOT PENETRATE GRADE BEAMS. UNLESS APPROVED BY STRUCTURAL ENGINEER.**

3.03 PERMITTED RACEWAY USAGE:

A. Raceway transitions at all locations:

1. Rigid nonmetallic conduit runs from below grade level shall transition to galvanized rigid steel or intermediate steel conduit, wrapped with corrosion protection tape, prior to exiting at grade level except where Schedule 80 PVC is specifically required by the electric utility for service conduits only. Conduit type shall continue thereafter in accordance with their usage requirements.
 - a. Caulk concrete-to-conduit joints with a silicone rubber compound.
2. Continue the more protective conduit type into an area where a less protective conduit type is permitted for a distance of not less than 1 foot.

B. Electrical metallic tubing at:

1. Interior locations when:
 - a. Concealed within walls and ceilings or **do not use in the mortar filled cells of concrete masonry units.**
 - b. Exposed and more than 8 feet above finished floor or
 - c. Exposed and more than 3 feet above finished floor in electrical or mechanical rooms or
 - d. Exposed and more than 1 foot above a finished attic or mezzanine floor.
 - e. Do not use where exposed to standing water or other continuously damp or wet areas.
2. Exterior locations when:
 - a. More than 10 feet above the finished ground surface or
 - b. More than 1 foot above the finished ground surface within a lockable equipment yard or
 - c. In the crawl space below a building with the 1st level elevated.

C. Rigid or intermediate metal conduit at:

1. Interior locations when:
 - a. Exposed, in other than electrical or mechanical rooms, and installed less than 8 feet above finished floor or
 - b. Exposed in electrical or mechanical rooms and installed less than 3 feet above finished floor or
 - c. Exposed and less than 1 foot above a finished attic floor or mezzanine floor.

2. Exterior locations when:
 - a. Less than 10 feet above the finished ground surface or
 - b. Less than 1 foot above the finished ground surface within a lockable equipment yard.
 - 1) Malleable iron straps will be required at these locations.
- D. Rigid metal and intermediate metal conduit wrapped with corrosion protection tape or rigid nonmetallic conduit at:
 1. Underground locations with a ¾" minimum size when:
 - a. Located outside of the building line or
 - b. Located below a concrete slab on grade or
 - c. Located below a beam of a slab on grade or.
 - d. Located within a concrete slab on grade where the outside diameter is equal to or less than 20 percent of the slab thickness.
 - 1) Seal conduit ends at each building entry.
 2. Below grade:
 - a. The minimum size shall be 3/4 inch.
 - b. Seal conduit ends at each building entry.
 - c. Coordinate covering with Structural Engineer.
- E. Rigid nonmetallic conduit for:
 1. An exposed grounding electrode or bonding conductor below 10 ft. to guard from physical damage.
- F. Flexible metal conduit in:
 1. Dry interior locations with a minimum length of 2 feet and maximum length of 6 feet to:
 - a. The final connection of transformers, motors, and vibrating equipment.
- G. Flexible metal conduit or metal-clad cable for light fixtures or ceiling mounted devices.
 1. Dry or damp interior locations with a maximum length of 6 feet to:
 - a. The final connection of light fixtures; or
 - b. The final connection of ceiling mounted outlet boxes or.
- H. Flexible metal conduit is not allowed for any technology rough-in, must be EMT.

- I. Liquid-tight flexible metal conduit in:
 1. All locations with a minimum length of 2 feet and maximum length of 6 feet for
 - a. The final connection of all liquid pump motors and associated control connections
or
 2. Damp or wet interior and all exterior locations with a minimum length of 2 feet and maximum length of 6 feet to
 - a. The final connection of transformers, motors, and vibrating equipment.

END OF SECTION

SECTION 26 05 34 - OUTLET BOXES, PULL BOXES AND JUNCTION BOXES

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Provide outlet boxes in accordance with the National Electrical Code at locations shown on the Drawings and hereinafter specified.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. **Provide standard hot-dipped galvanized pressed steel boxes, minimum 4"x4" by 1-1/2" deep. Use 4 11/16" by 2 1/8" deep box when using 1" conduit.**
- B. Cabinets with screw covers or as specifically noted for junction or pull boxes larger than 150 cubic inches.
- C. All junction, pull and splice boxes to conform to NEC Article 314.
- D. All metallic boxes are to have an internal means of grounding.
- E. Flush mounted wall and finished ceiling boxes.
 - 1. Within framed, drywall, plastered or tile covered walls, with 3/4" max. raceway, furnish galvanized steel, 4" square, minimum 1 1/2-inch-deep boxes with a raised tile cover and a far-side support.
 - 2. Within drywall or plaster covered or suspended ceilings, with 3/4" max. raceway, furnish galvanized steel, 4" square, minimum 1 1/2-inch-deep boxes with a raised tile cover.
 - 3. Within masonry walls, with 3/4" max. raceway, furnish galvanized steel boxes, minimum 2-1/2-inch deep.
- F. Surface mounted boxes.
 - 1. Mounted at or below 10' above the finished surface, 3/4" max. raceway size, furnish cast aluminum boxes with a surface mounted cover.
- G. Junction and Pullboxes.
 - 1. Furnish, minimum 4" square, 1 - 1/2" deep, galvanized steel junction and pullboxes where installation conditions warrant their use. Boxes shall be furnished with screw-on covers or hinged covers. Covers shall be such that it can easily be handled by one person. All hardware and fasteners shall be galvanized steel.
- H. Flush mounted floor boxes.
 - 1. Furnish adjustable, concrete tight, corrosion resistant, duplex type. Compartmental type for combination receptacle and communication. The coverplate shall be brass with hinged flap and carpet flanges. The minimum below ground/slab conduit size shall be 3/4".

- I. Underground boxes.
 1. U. L. listed.
 2. Pre-cast, polymer concrete.
 3. Minimum size of 10" W X 10" L X 10" H.
 4. Bolt down cover.
 5. Stainless steel hex-bolts and replaceable nuts.
 6. Minimum load rating of 5,000 lbs. (select by location)

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Through wall boxes and boxes mounted back-to-back are not permitted. Provide 8 inch minimum separation in order to minimize sound transmission.
- B. Set flush with wall or ceiling finish in accordance with N.E.C., Article 314. Extension sleeves are not permitted for boxes improperly set.
- C. Verify location of outlets prior to rough-in. When necessary, relocate outlets to avoid interference with other work or equipment. Where fixtures are mounted on or in an accessible type ceiling, provide a junction box and extend flexible conduit to each fixture. Fit outlet boxes in finished ceilings or walls with appropriate covers.
- D. Where more than one (1) switch or device is located at one (1) point, unless otherwise indicated, provide gang boxes and covers. When the voltage between switches exceeds 300 volts, provide barrier partitions between adjacent switches located in the same box. Sectional switch boxes or utility boxes not permitted.
- E. Provide pressed steel boxes for all interior work. Provide square boxes with plaster rings. Provide appropriate size multi gang box for group devices. Single gang boxes screwed together is not acceptable.
- F. Where boxes are installed in masonry walls, use only approved masonry type boxes for single gang and multi-ganged applications. Standard 4" square boxes with plaster rings are not allowed. Caulk around joint between receptacle box and masonry. Verify color with architect.
- G. Do not drill and pierce structural concrete members and structural steel without prior approval of the Engineer.
- H. Mount all boxes plumb.
- I. Mount boxes completely rigid without conduit or finished wall support.
- J. Where outlets are installed in steel stud type systems, provide additional cross bracing, bridging, and/or straps as required to make the outlet completely rigid. Support boxes with "caddy screw gun brackets", "caddy box mounting bracket", "caddy quick mount box brackets" or acceptable alternates.

- K. **Dimensions are from finished floor to centerline of devices.** Adjust heights of devices in masonry walls from that indicated so that receptacles are not lower than 16" A.F.F. and switches are not higher than 46" A.F.F. Adjusted device height shall be consistent. Unless otherwise indicated, mount devices at the following heights:

Wall switches/Wall Phone	3 ft. - 8 in.
General Duplex receptacles	1 ft. - 6 in.
Receptacles at Millwork	verify with millwork
Receptacle for Refrigerators	2 ft – 6 in.
Weatherproof duplex receptacles	1 ft. - 6 in.
Telephone/Data outlets/Teacher Station	1 ft. - 6 in.
Telephone/Data at millwork	verify with millwork
Garages/Apparatus Bay receptacles	2 ft. - 0 in.
Clocks	8 ft – 0 in
Access Point Data Drops (wall mounted)	10 ft – 0 in

- L. For boxes installed above ceilings, label the box cover with the circuit numbers installed. Labeling shall be with a permanent, black marker with broad tip.
- M. Boxes installed in rated walls shall have a minimum horizontal separation of 24". Maximum surface area of boxes shall not exceed 16 square inches.
- N. Completely envelope floor boxes in concrete except at the top. Increase slab thickness at boxes if required for bottom covering. Adjust covers flush with finished floor.
- O. Where outlets are indicated adjacent to each other, mount these outlets in a symmetrical pattern with all tops at the same elevation. Where outlets are indicated adjacent, but with different mounting heights, line up outlets to form a symmetrical vertical pattern on the wall.
- P. Install recessed boxes flush to the finished wall or ceiling line by the use of manufactured tile rings to extend the box forward.
- Q. Boxes to which light fixtures or pendants are mounted shall NOT contain any conductors foreign to the operation of such light or pendant application. Removal of lights, pendants and cord drops to access other branch circuits is NOT acceptable.
- R. Where fixtures are mounted on or in an accessible type ceiling, provide a junction box and extend flexible conduit to each fixture.
- S. Install knockout closures to cap all unused openings.
- T. All boxes shall be installed with coverplates.
- U. Install boxes as required to facilitate conductor installation in raceway systems. Junction and pull boxes shall be sized to accommodate conductors, splices, devices and fittings per NEC 314.16.

- V. Raceways are NOT allowed to terminate to extension rings.
- W. Install boxes so that covers are accessible and easily removable after completion of the installation. The minimum clear space in the direction of the box opening shall be 36".
- X. Include suitable access doors, with the proper fire rating, for boxes above inaccessible ceilings. Boxes shall be located within reach of the access.
- Y. Install underground boxes with cover slightly above finished grade.
- Z. **Spray paint J-Boxes red for Fire Alarm Systems. All other special system J-Boxes to be painted white.**

END OF SECTION

SECTION 26 05 80 - EMPTY RACEWAY ROUGH-IN

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish and install all equipment, accessories and material required for the rough-in of empty raceway systems in accordance with the specifications and drawings.
- B. Rough-in raceway sections for indicated devices and outlets in all walls, floors and underground sufficient to facilitate installation of the following systems without cutting or otherwise damaging walls, ceilings or floors installed in this contract:
 - 1. Communications
 - 2. Fire Alarm
 - 3. Television
 - 4. Data
 - 5. Security
 - 6. Controls
- C. **ALL CONDUITS SHALL HAVE A PULL CORD INSTALLED. INSTALL BLANK COVERS ON ALL UNUSED JUNCTION BOXES.**
- D. 3/4" CONDUIT MINIMUM.
- E. Electrical Contractor shall provide all conduit, junction boxes and outlet boxes for HVAC controls as specified in Section 26 05 00, 1.03, E. Coordinate locations and requirements with Mechanical Contractor and Controls Contractor prior to rough-in. Provide outlet box for sensor and conduit to above accessible ceiling. Provide conduit for all wiring in areas with no ceiling. Provide conduit from outdoor units to above accessible ceilings. Provide conduit between make-up air units and associated condensing units.
- F. **REFERENCE TECHNOLOGY DRAWINGS AND SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS CONCERNING CONDUIT ROUGH-IN FOR VOICE/DATA SYSTEMS.**
- G. Floor mounted devices: Provide pathway to nearest accessible ceiling for all floor mounted devices called for in this specification.
- H. Unless otherwise noted, all conduits are expected to be concealed inside walls or above ceiling. In areas with open ceilings that require exposed conduits, all conduits shall be routed perpendicular or parallel to building lines with final routing approved by the architect or engineer prior to installation.

1.02 QUALITY ASSURANCE

- A. Construct each item of equipment, including parts and accessories, in a workmanlike manner, using new materials or the best quality obtainable for the purpose intended. Design and build materials in accordance with the best practices of the electrical industry.

- B. Comply with all requirements of serving utility.

PART 2 - EXECUTION

2.01 INSTALLATION

- A. Interior conduit systems shall have runs less than 100 feet from point to point.
- B. Provide accessible pull boxes when necessary. Provide blank covers for all outlet boxes, unless otherwise noted.
- C. All bends for telephone and cable television service shall be 36-inch radius, minimum.
- D. Provide outlet box in wall at 18" A.F.F. (UON) and conduit with string to above accessible ceiling location. Provide insulated bushing on end of conduits.
- E. **Provide twelve (12) additional outlet boxes and conduit with pull cord to above the ceiling. Final location shall be as directed by the Architect. Outlets can be added at any phase of construction with the exception of finished CMU walls.**

END OF SECTION

SECTION 26 24 13 - MAIN SWITCHBOARD

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall provide and install a switchboard as shown on the drawings and as hereinafter specified.
- B. The Contractor shall verify that all factory bussing and related equipment is properly connected, aligned, properly phased and identified. All bolts and connections shall be tightened as required by the manufacturer's instructions.
- C. Manufacturer to do a coordination study and provide contractor with proper trip setting for all breakers where applicable.
- D. Surge Protective Devices. Reference Riser Diagram and Surge Protective Devices specification.
- E. Provide metering. Reference Riser Diagram.

1.02 STANDARDS

- A. The switchboard shall be UL listed and labeled for service entrance and shall comply with the applicable NEMA Standards, ANSI Standards, and the NEC.

1.03 ACCEPTABLE MANUFACTURERS

- A. Square D / Schneider Electric
- B. Siemens
- C. General Electric/ABB
- D. Eaton

1.04 SUBMITTALS

- A. Submit Manufacturer's technical product data on the switchboard, protective devices and instrumentation. Include data substantiating that materials comply with the requirements of this section.
- B. Submit shop drawings which include dimensions, top and bottom views showing entry and exit space for conduits, front and side elevations showing arrangement of all scheduled and future devices, dimensional data on all buses including material type and capacity of the buses and the short circuit ampere interrupting rating.
- C. Submit one-line diagrams for the switchboard being provided. Also submit information on all protective devices including the type and ratings.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Furnish a complete factory assembled switchboard from incoming line lugs to load terminals of all branch protective devices. Include all necessary buses, supports, devices and provisions for future connections as shown. Switchboard to be circuit breaker type.
- B. The physical size and configuration of the switchboard may be varied to suit the manufacturer's standard design, provided the intended functions are accomplished. Any change in size or configuration must be noted on the submittal.
- C. The manufacturer of the switchboard shall be the same as the manufacturer of the switches mounted in the switchboard.
- D. All new panelboards and switchboards on this project shall be by the same manufacturer as the switchboard.
- E. Service entrance switchboards shall include a separately mounted, dual listed transient voltage surge suppression device with a secondary surge arrester.
- F. Power meter that measures a minimum of KW, Volts, KWH, Power Factor on all 3 phases, sends pulses that can be read by Owner's DDC.
- G. Provide IR windows at the switchboard to allow for thermal imaging of all terminations.

2.02 RATINGS

- A. Provide plated copper bussing of the ampere rating shown on the Drawings. Neutral bus shall have the same ampere rating as the phase bus. Each switchboard, as a complete unit, shall have a short circuit current rating equal to or greater than the integrated equipment short circuit rating shown on the switchboard schedule or on the plans. This rating shall be established by testing with the branch devices mounted in the switchboard. Short circuit tests on the overcurrent devices and on the switchboard structure, shall be made simultaneously by connecting the fault to each overcurrent device with the switchboard connected to its rated voltage source. Method of short circuit testing shall be per Underwriters Laboratories Standard. The source shall be capable of supplying the specified switchboard short circuit current or greater. Testing of switchboard overcurrent devices for short circuit rating only while individually mounted is not acceptable. Also, testing of the bus structure by applying a fixed fault to the bus structure alone is not acceptable. Switchboards shall be marked with their maximum short circuit rating at the supply voltage and shall be UL listed. The bus shall have a temperature rise of 65OC. above an ambient temperature of 40OC. There shall be no reduction of through (horizontal) bus. Vertical bus shall be full height.
- B. Series rating not permitted.
- C. Final AIC ratings for all panels shall be determined and provided by the gear manufacturer to meet minimum allowable fault current from utility company transformer. Provide coordination study, arc flash analysis, and fault current analysis as required for justification of sizes. Make all changes required by coordination and arc flash study and include in bid price. Coordination study must be completed prior to submitting gear.

2.03 ENCLOSURE

A. Construction.

1. Fabricate the switchboard enclosure with the required number of vertical sections. Sections shall align at top, bottom, front and rear. Bolt vertical sections together to provide a rigid freestanding unit. Fit in the space designated and as shown on the drawings.
2. Completely enclose the frame with removable, bolted, code-gage sheet steel covered panels. Form all cover plates and doors to eliminate sharp edges.
3. Where indicated on the drawings or installed outdoors the enclosure shall be suitable for outdoor installation and be provided with hinged, lockable doors.

B. Access.

1. Furnish an assembly which permits front access to the buses and devices.
2. Hinge all doors which provide access to protective device load terminals.
3. Furnish adequate wiring gutter space at top, bottom and sides for easy access to all wiring terminations.

C. Lifting Provisions.

1. Provide permanent lifting means on the top of each section.

D. Finish.

1. Grind all steel surfaces smooth, with all burrs, sharp edges, welding splatters, loose rust, scale and the like totally removed after fabrication.
2. Inside and outside surfaces shall be properly cleaned, primed, and a finish coat of gray paint applied.
3. Supply one quart of finish paint for each switchboard for touch-up after installation.

E. Labeling.

1. Provide factory applied Arc Flash Labels per NEC 110.16.

2.04 BUS CONSTRUCTION

- A. Fabricate all buses of 98 percent IACS conductivity, copper with rounded edges.
- B. Size buses to limit their temperature rise within the switchboard to 65°C based on a 40°C ambient temperature.
- C. Size all buses so that current density will not exceed 1000 amperes per square inch.
- D. Support the bus systems using non-carbonizing, non-tracking insulators.
- E. Insulate each individual phase bus to withstand 2000 volts a-c for 1 minute.

- F. Size the supply and through (horizontal) bus on the total switchboard's load current shown on the drawings or schedules.
- G. At the minimum, size the sectional (vertical) bus on the load currents served by the devices within each section, including capacity for spaces. A further minimum of 60 percent of the through bus rating must be maintained. Extend the sectional (vertical) phase buses the height of the switchboard.
- H. Extend the phase and neutral through (horizontal, supply) buses to all sections with busses sized at the maximum switchboard's amperage rating. Provide for through bus extensions from either end.
- I. Fully equip spaces for future devices, including all appropriate connectors and mounting hardware.
- J. Each switchboard section shall include a pre-drilled, un-insulated, ground bus bar. Secure the bar to the frame and extend to adjacent sections, thus providing a continuous equipment ground bus. Arrange the equipment ground bus to ground the switchboard parts which do not carry current. Include terminals for feeder and branch circuit grounding conductors. Make the cross-sectional area of the ground bus not less than one square inch.
- K. Device Mounting.
 - 1. Assembly must permit interchanging devices of the same type, rating and method of operation.
 - 2. Construction shall permit devices to be field installed.
 - 3. Devices shall be front removable and load connections shall be front accessible enabling the switchboard to be mounted against a wall.

2.05 CABLE TERMINATIONS

- A. All mechanical-type terminals shall be UL Listed to accept copper conductors. Lugs shall be suitable for 75° C temperature rating.
- B. Provide phase and neutral lugs to accommodate the conductors shown on the associated drawings or schedules.
- C. Provide grounding lugs for the connection(s) of the main grounding electrode conductor(s) in the service conductor section.
- D. Provide additional grounding lugs for the equipment grounding connection(s).

2.06 SERVICE ENTRANCE BARRIERS

- A. Barriers shall be placed such that no un-insulated, ungrounded busbar or terminal is exposed to inadvertent contact by persons or maintenance equipment while servicing load terminations.

2.07 CIRCUIT BREAKERS

- A. Furnish breakers with the number of poles and protective devices required as shown on the drawings or schedules.
- B. Furnish breakers and protective devices which are fully rated for the short circuit indicated.

- C. Breakers shall utilize bolted line bus connections.
- D. Breaker shall be equipped with all required mounting brackets and guides.
- E. Operating handles shall be mounted as an integral part in the operating mechanism with a visible ON/OFF switch indication.
- F. Breakers feeding transformers shall include a permanently installed locking device suitable for a padlock to lock the device in the off position.
- G. Sub-feed breakers shall never be smaller than the panel/MCB rating of the panel being fed. Contractor to verify prior to submittal and contact engineer with any discrepancies.
- H. Where voltage to ground is more than 150 volts and the ampacity rating of the main circuit breaker exceeds 1000 amps, the main breaker shall be provided with ground fault protection as required by NEC 230.95. When provided, contractor shall perform the required performance testing in compliance with NEC 230.95 (C) and make available to the AHJ. Provide copy of testing in O&M manuals.
- I. Where the ampacity rating of a circuit breaker indicated in the plans requires arc energy reduction per NEC, the equipment shall be provided complete with a code compliant arc energy reduction system with status indicator.

2.08 LISTING

- A. The completed switchboard shall be UL listed.
- B. When required, the switchboard shall be UL listed as suitable for use as service entrance equipment.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The switchboard sections shall be set in place, assembled, carefully aligned, made plumb on all faces. All connections and installations shall be in accordance with the manufacturer's recommendations and installation instructions. Clearances shall comply with Article 110 and installation with Article 384, NEC.
- B. Free standing main switchboards shall rest on a 3-1/2" housekeeping pad. Coordinate with the General Contractor.
- C. Make and torque field connections of buses between switchboard sections with splice bus and hardware provided by the switchboard manufacturer.
- D. Restore all damaged surfaces to factory finish.
- E. Thoroughly inspect and remedy the switchboard for the presence of foreign materials.

END OF SECTION

SECTION 26 24 16 - BRANCH CIRCUIT PANELBOARDS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Provide branch circuit panelboards as shown on the Drawings and as herein specified.
- B. Panelboard feeders are sized from the "Panelboard Connection Schedule". When a panel is fed from a transformer use the "Transformer Connection Schedule" for feeder size. When there is a conflict between the sizes, use the largest of the two.
- C. Confirm Breakers sub-feeding Panels and Transformers with supporting Panel and Transformer schedules prior to submittal.
- D. This section specifies the furnishing and installation of molded case, thermal-magnetic circuit breakers. Electronic, solid-state trip circuit breakers are NOT allowed.
- E. Maximum circuits per panelboard section shall be 42 circuits.

1.02 STANDARDS

- A. Provide U.L. label.
- B. Comply with applicable standards of NEMA and the NEC.

1.03 ACCEPTABLE MANUFACTURERS

- A. Square D / Schneider Electric
- B. Siemens
- C. Cutler Hammer / Westinghouse / Eaton
- D. General Electric / ABB

1.04 SUBMITTALS

- A. Furnish Engineer shop submittal for each branch circuit panelboard.
- B. Submit shop drawings for each panelboard which include outline and support points, dimensions, voltage, main bus ampacity, short circuit ampere interrupting rating, circuit breaker arrangement, sizes and number of poles. Shop drawing shall list all spaces and circuit breakers to be installed in each panelboard.
- C. Provide shop submittal which includes the following:
 - 1. Cabinet
 - a. Housing
 - b. Trim
 - c. Outline dimensions

- d. Available spaces
- e. Panelboard mounting
- 2. Circuit breakers
 - a. Frame size
 - b. Trip setting
 - c. Class
 - d. Interrupting rating in RMS Symmetrical amperes
 - e. Mounting
 - f. Voltage rating
- 3. Busing
 - a. Ampere rating
 - b. Material
 - c. Incoming cable lug size
 - d. Bus bracing
- 4. Manufacturer's catalog numbers.
- 5. Other descriptive data as may be required.
- D. **Circuit breaker arrangement must be identical to the schedules or one-line diagram, unless there is a technical reason for deviation. All reasons for deviation must be stated on the shop drawings.**
- E. **If a multipole breaker crosses across panel section, contractor to shift circuit and mark up in as-builts.**
- F. **Unless specifically noted, only Max 42 circuits per section will be allowed.**
- G. **Breakers feeding transformers shall include a permanently installed locking device suitable for a padlock to lock the device in the off position.**
- H. **Where electrical panels are to be installed in a small closet where the door opening is to be used for service clearance, the full panel height shall not exceed a 7'0" door height and shall allow hinged front panels to open fully.**
- I. **Sub-feed breakers shall never be smaller than the panel/MCB rating of the panel being fed. Contractor to verify prior to submittal and contact engineer with any discrepancies.**
- J. **Sub-feed breakers for Transformers shall never be smaller than the Transformer Connection Schedule rating of the size being fed. Contractor to verify prior to submittal and contact engineer with any discrepancies.**

- K. **Contractor must include “Mechanical/Electrical Coordination Sheet” completed prior to Gear Submittal.**
- L. **Contractor to Verify Voltage, Amperage and Phasing of all major equipment prior to gear submittal.**

PART 2 - PRODUCTS

2.01 GENERAL.

- A. All new panelboards and switchboards on this project shall be by the same manufacturer. The manufacturer shall be the same as the manufacturer of the circuit breakers.
- B. Interior trim shall be of dead-front construction to shield user from energized parts. Dead-front trims shall have pre-formed covers for unused mounting space.
- C. Interior leveling provisions shall be provided for flush mounted applications.
- D. Panelboards shall be designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.
- E. Furnish suitable lugs for each conductor requiring a connection.
- F. All branch circuit panelboards to be provided with feed through lugs.

2.02 BUS CONSTRUCTION

- A. Fabricate all buses of 98 percent IACS conductivity, copper. Size buses to limit their temperature rise within the panelboard to 65°C based on a 40°C ambient temperature.
- B. Provide one continuous, un-reduced in size, bus bar per phase with “distributed phase” or “phase sequence” type connections to the branch circuit breakers. Extend the buses the height of the panelboard.
- C. Provide circuit breaker connections to the bus by means of a bolt. Square D “I-Line” may be provided.
- D. Insulate each individual phase bus to withstand 2000 volts a-c for 1 minute.
- E. Support the bus systems using non-carbonizing, non-tracking insulators.
- F. Furnish fully equipped spaces, include all appropriate connectors or mounting hardware.
- G. Furnish an insulated neutral bus which is the same size as the phase buses. Larger sizes may be required by the schedules or one-line diagram.
- H. Furnish a solidly bonded equipment ground bus. Include terminals for feeder and branch circuit grounding conductors.
- I. Furnish an isolated ground bus, with terminals, where scheduled or noted on the drawings.
- J. Provide full size or larger insulated neutral bus bar. Where specified on the panel schedule, provide 200% rated neutral bus bar. Coordinate with plans.

2.03 RATINGS

- A. Panelboards and circuit breakers shall be rated for 60 hertz and have a voltage and current rating as indicated on the drawings or schedules.
- B. The finished panelboard assembly shall be fully rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault currents indicated on the drawings or schedules. The minimum rating for a 240-volt a-c panelboard shall be rated 10,000 AIC RMS symmetrical and a 480-volt a-c panelboard shall be rated 14,000 AIC RMS symmetrical minimum. Series ratings are not permitted.
- C. **Final AIC ratings for all panels shall be determined and provided by the gear manufacturer to meet minimum allowable fault current from utility company transformer. Provide coordination study, arc flash analysis, and fault current analysis as required for justification of sizes. Make all changes required by coordination and arc flash study and include in bid price. Coordination study must be completed prior to submitting gear.**

2.04 ENCLOSURES

- A. Enclosures shall be at least 20 inches wide and made from galvanized steel with welded interior mounting studs. Provide gutter space in accordance with the National Electrical Code. Where conductors are carried through a box, the box shall be sized to include the additional space. Enclosures shall be fully enclosed.
- B. **ALL MULTI-SECTION PANEL ENCLOSURES SHALL BE THE SAME HEIGHT.**

2.05 HINGED FRONT COVER

- A. Mounting shall be flush or surface, as indicated on associated schedules or drawings. Surface trims shall be the same height and width as the box. Flush trims shall overlap the box by 3/4 of an inch on all sides.
- B. Fronts shall be of the concealed hinged type. Front shall not be removable with the door closed.
- C. Doors on front shall have rounded corners; edges shall be free of burrs. Doors shall have a flat latch type lock with a catch and spring-loaded stainless-steel door pull. All lock assemblies shall be keyed alike. One key shall be provided with each lock.
- D. Furnish a nameplate, circuit directory frame, card and a clear plastic covering on the inside of the door. All loads shall be identified as specified in Section 16075.
- E. Provide factory applied Arc Flash Labels per NEC 110.16.

2.06 FINISH

- A. Surfaces of the trim assembly shall be properly cleaned, primed, and a finish coat of gray paint applied.
- B. Nema 3R enclosures shall be properly cleaned, primed, and a finish coat of gray paint applied.
- C. Supply one quart of finish paint for each project. Touch-up after installation.

2.07 MOLDED CASE THERMAL-MAGNETIC CIRCUIT BREAKERS

- A. Furnish molded case, thermal-magnetic circuit breakers in lighting / appliance and power distribution panelboards for the specified service with the number of poles and ampere ratings indicated on the schedule or drawings. Incorporate inverse time characteristic by bi-metallic overload elements and an instantaneous characteristic by magnetic trip.
- B. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
- C. Circuit breakers shall have a trip free, toggle operating mechanism which will provide quick-make, quick-break contact action. The circuit breaker shall have common tripping of all poles.
- D. The circuit breaker handle shall reside in a tripped position between ON and OFF to provide local trip indication. Circuit breakers shall be clearly marked ON and OFF.
- E. Circuit breakers shall be factory sealed.
- F. All circuit breakers shall be suitable for mounting in any position.
- G. Circuit breakers shall be equipped with factory installed mechanical lugs.
- H. Circuit breakers shall have a permanent trip unit containing individual thermal and magnetic trip elements in each pole.
- I. Thermal trip elements shall be factory preset and sealed. Circuit breakers shall be true rms sensing and thermally responsive to protect circuit conductor(s) in a 40° C ambient temperature.
- J. For 2-pole and 3-pole breakers, use the common-trip type so that an overload or fault on one pole will trip all poles simultaneously. Handle ties are not acceptable except where multiple single breakers are used to serve modular furniture.
- K. Where indicated, provide ground fault (GFCB) or shunt trip breakers.
- L. Where the ampacity rating of a circuit breaker indicated in the plans requires ground fault protection per NEC, the equipment shall be provided complete with the required components to provide ground fault protection of the circuit.
- M. Where the ampacity rating of a circuit breaker indicated in the plans requires arc energy reduction per NEC, the equipment shall be provided complete with a code compliant arc energy reduction system with status indicator.

2.08 LISTING

- A. The completed panelboard shall be UL listed.
- B. Certification standards, with applicable voltage systems and corresponding interrupting ratings, shall be clearly marked on the face of each circuit breaker.
- C. Circuit breakers shall be equipped with listed electrical accessories as noted on the schedules or drawing.
- D. When required, circuit breakers shall be listed as HACR type.
- E. When required, circuit breakers shall be listed as Switch Duty type.

- F. When required or indicated on the drawings or schedules, equipment shall be listed for the environment in which it is installed.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install box, trim and interior rigid and plumb. Center interior with opening.
- B. Install panelboards in accordance with the instructions of the manufacturer and as shown on the Drawing. Install complete with all required electrical connections.
- C. Unless otherwise noted, install panelboards with the top of the trim 6 ft. 0 in. above finished floor.
- D. Field check panelboard loading and reconnect circuits as required to provide balanced phase and line loads.
- E. Neatly bundle, route and support cables installed in wiring gutters of panelboards. Minimum bending radii as recommended by the wire and cable manufacturer.
- F. Install five (5) 3/4" conduits from top of flush mounted panelboards to accessible void above ceiling. Cap end of conduits above ceiling.
- G. All recessed panels are to be installed in 6" minimum wall thickness. Coordinate clear dimensions with Architect and General Contractor prior to rough-in.
- H. Provide wood trim for any semi-recessed panels, including panelboards. Coordinate with General Contractor and verify finishes with the Owner/Architect.
- I. Install filler blanks for any unused breaker space.
- J. All panel interior to be free of debris and dirt prior to installing panel covers.
- K. Check bolted and circuit breaker connections using a torque wrench.
- L. The faces of all circuit breakers shall be flush with each other.
- M. Affix permanent and individual circuit numbers to each circuit breaker in a uniform position.

END OF SECTION

SECTION 26 27 26 - DEVICES

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Provide switches and receptacles as shown on the drawings and as hereinafter specified.

1.02 STANDARDS

- A. Provide all receptacles which conform with NEMA standards for amperage and voltage classification.
- B. Provide devices U.L. listed for the application and for the type of wire used.

1.03 ACCEPTABLE MANUFACTURERS

- A. Hubbell, Leviton, LeGrand or approved equal

1.04 SUBMITTALS

- A. Furnish Engineer shop submittal for each device.
- B. Provide shop submittals which include the following information:
 - 1. Manufacturer and catalog number.
 - 2. NEMA configuration.
 - 3. Voltage and amperage ratings.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Straight Blade Receptacles: Furnish Leviton receptacles or approved equal, color shall be White. (Devices and coverplates connected to emergency circuits shall be red).
 - 1. Single receptacle, 20 amp, 125-volt, 2-pole, 3-wire, grounding, NEMA 5-20R.
 - 2. Single receptacle, 20 amp, 250-volt, 2-pole, 3-wire, grounding, NEMA 6-20R.
 - 3. Duplex receptacle, 20 amp, 125-volt, 2-pole, 3-wire, grounding, NEMA 5-20R.
 - 4. Tamper resistant, duplex receptacle, 20 amp, 125-volt, 2-pole, 3-wire, grounding, NEMA 5-20R.
- B. Toggle Switches: Furnish Leviton switches or approved equal, color shall be White. (Devices and coverplates connected to emergency circuits shall be red).
 - 1. Single pole, single throw, 20-amp, 120/277 volt.
 - 2. Single pole, double throw, momentary, 20-amp, 120/277 volt.

3. Single pole, double throw, maintained, 20-amp, 120/277 volt.
 4. Double pole, single throw, 20-amp, 120/277 volt.
 5. Three-way, single throw, 20-amp, 120/277 volt.
 6. Four-way, single throw, 20-amp, 120/277 volt.
- C. Locking Switches: Furnish Leviton switches with #55500 key, color shall be White. (Devices and coverplates connected to emergency circuits shall be red).
1. Single pole, single throw, 20-amp, 120/277 volt.
 2. Single pole, double throw, momentary, 20-amp, 120/277 volt.
 3. Single pole, double throw, maintained, 20-amp, 120/277 volt.
 4. Double pole, single throw, 20-amp, 120/277 volt.
 5. Three-way, single throw, 20-amp, 120/277 volt.
 6. Four-way, single throw, 20-amp, 120/277 volt.
- D. NLight Lighting Control Devices: Provide white devices as standard with stainless steel device plate. **(Devices on emergency circuits to have red plates and white devices).**
- E. Dimmer Switches: Furnish Lutron NT series, or equivalent, continuously adjustable slide dimmer with preset on/off switch. Dimmer shall be solid-state type for use with 120-volt incandescent lamps and shall have electromagnetic filters to eliminate noise, RF and TV interference. Dimmer wattage is indicated on the drawings or 1000 watt minimum.
- F. Ground Fault Devices: Color shall be White. (Devices and coverplates connected to emergency circuits shall be red).
1. Ground fault circuit interrupter (GFCI), 20 amp, 125-volt, 2-pole, 3-wire, grounding, NEMA 5-20R.
 2. Ground fault feed through switch, 20 amp, 125-volt.
- G. Device Plates:
1. Unless otherwise indicated, provide smooth metal device plates of Type 430 stainless steel for all indoor devices. Verify color with architect prior to ordering. Cover plates for devices served by emergency circuits shall be red.
 2. Provide telephone and data outlets with blank metal type 430 stainless steel covers.
 3. Provide properly gasketed vertical single lift device plate of aluminum die cast for weatherproof receptacles and/or switches.
- H. Floor Outlets:
1. Provide where shown on the drawings, PVC rectangular floor boxes. Coordinate all dimensions for floor boxes with Architect. Contractor shall not scale from drawings.

2. Receptacle floor outlets specified as duplex shall have duplex screw cap coverplates. Telephone and/or data floor outlet boxes to have combination screw cap coverplate.
 3. Provide brass carpet flanges for each floor box installed in carpeted areas.
 4. Multiple device locations shall incorporate two (2) or three (3) gang outlet box.
- I. Provide GFI receptacles within 6 feet of any sink, lavatory, wet area and outdoors. All GFI resets to be located in the same room protected.
 - J. Provide GFI protection for all receptacles in areas where power hand tools or portable lights are used (shop areas, garages, etc.).
 - K. Provide GFI protection for all circuits used for heat tracing.
 - L. Provide a receptacle in all mechanical/electrical rooms.
 - M. Surge Arresting Receptacles: Where surge arresting receptacles are indicated, provide receptacles meeting Federal Specification WC-596F which are UL listed (UL 1449 and UL 498) with integral surge suppression. Provide with audible surge protection failure alarm and replaceable surge arrester module. Eagle Electric "Super Spec SurgeBloc" or acceptable equal.
 - N. All 120volt/20amp receptacles in kitchen area to be GFCI protected.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install wiring devices of the type as indicated on drawings. Make up all connections tight and set device plumb. Use care in installing device in order to prevent damage to the device and the wire in the outlet box.
- B. Device Plates: Provide a device plate for each outlet to suit the device installed and install blank plates or covers for junction boxes and empty outlets, including telephone, computer, etc.
- C. Mount duplex receptacles vertically with grounding opening up unless otherwise noted.
- D. Prior to installation of outlets other than 20A, 120 Volts, verify receptacle type with Owner through Architect. Receptacles not verified shall be changed at Electrical Contractor's expense if necessary, to operate equipment.
- E. Install all switches that are required to be handicap accessible at proper height per latest ADA Standards.
- F. Install wall switches vertically in an outlet box on the strike side of the door as finally hung.
- G. Install single throw switches so up is the ON position.
- H. Locking switches shall be furnished in corridors, common areas and any area with HID lighting. Contractor shall confirm exact location of all locking switches with the Architect/Engineer prior to rough-in.

- I. Provide "Caddy Screw Gun Bracket" between wall studs, as required to install switches, thermostats, intercom devices, etc. Verify exact location of devices prior to rough-in. Device boxes shall be aligned on center line of each box.
- J. Receptacles installed for electric water coolers shall be mounted at a height so as not to be visible after installation of EWC. Coordinate with equipment being provided.
- K. Provide one (1) duplex GFI/weatherproof receptacle within 25 feet of all mechanical equipment, located on the roof, on mezzanines, or on the ground. Connect receptacles to nearest available circuit with not more than 6 receptacles or home run to the nearest available panelboard and provide breaker as required.
- L. Engrave coverplates, designated for engraving, with 1/8-inch-high contrasting lettering.
- M. Engrave the coverplates of wall switches that control equipment which is not in sight of the switch with the designation of the equipment being controlled. Lettering shall be 1/8-inch-high and of a contrasting color.
- N. All receptacles located above counter tops with sinks and receptacles in kitchens shall be GFI Type.
- O. **Tamper resistant receptacles must be provided where used in the locations described in NEC 406.12 including, but not limited to:**
 - 1. **Educational facilities**
 - 2. **Hotel/motel guest rooms and common areas**
 - 3. **Assisted living facilities**
 - 4. **Dwelling units/dormitories**
 - 5. **Offices, corridors and waiting areas of clinic/medical office buildings.**
 - 6. **Assembly occupancies as described in NEC 518.2.**
- P. **Provide eighteen (18) additional receptacles in base bid including wire, conduit, breakers and appurtenances. Each receptacle represents a dedicated circuit. Estimate length of circuit is 150 feet. Final location as directed by Architect.**
- Q. **Provide six (6) additional lighting control stations including wire and conduit. Estimated length to circuit is 75 feet. Final location is directed by architect.**
- R. **Provide six (6) additional motion sensors including wire and conduit. Estimated length to circuit is 75 feet. Final location is directed by architect.**
- S. **Provide unit price to add additional receptacles over base bid. Use same lengths indicated above.**

END OF SECTION

SECTION 26 28 10 - MANUAL MOTOR STARTERS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Provide and install manual motor starters per NEC and as hereinafter specified.

1.02 STANDARD

- A. UL Listed.
- B. Conform to the latest NEMA Standards.

1.03 ACCEPTABLE MANUFACTURERS

- A. Square D
- B. Cutler Hammer/Westinghouse
- C. ITE Siemens
- D. General Electric

1.04 SUBMITTALS

- A. Provide data sheets that include equipment voltage/current rating, catalog numbers, horsepower rating and other such descriptive data which may be required.

PART 2 - PRODUCTS

2.01 CONSTRUCTION

- A. All manual motor starter switches shall consist of toggle operated two (2) or three (3) pole switches mounted in a NEMA 1 general purpose enclosure unless exposed to outdoor conditions; then mount in NEMA 3R enclosure.
- B. Contacts shall be double break silver alloy.
- C. Terminals shall be supplied, clearly marked and accessible from front of switch.
- D. Switch shall be equipped with melting alloy type thermal overload relay. Thermal unit shall be of one-piece construction and inter-changeable. Starter shall be inoperative if thermal unit is removed.
- E. Toggle switch shall be furnished with a handle guard.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Securely mount switches in accordance with NEC and all local codes. Provide all mounting materials and hardware.
- B. Confirm with Mechanical and/or Plumbing Contractor prior to mounting switch on respective equipment.

END OF SECTION

SECTION 26 28 15 - SAFETY DISCONNECT SWITCH

PART 1 - GENERAL

1.01 SCOPE OR WORK

- A. Provide safety switches for all pieces of equipment per NEC as indicated on the Drawings and specifications or as required.
- B. **All safety switches are to be FUSED unless noted otherwise.**

1.02 STANDARDS

- A. Conform to U.L. listed and the latest NEMA standards.

1.03 ACCEPTABLE MANUFACTURERS

- A. Square D
- B. ITE Siemens
- C. Cutler Hammer/Westinghouse
- D. General Electric

1.04 SUBMITTALS

- A. Furnish Engineer shop submittal for safety disconnect switches.
- B. Provide shop submittals which include the following information:
 - 1. NEMA type
 - 2. Enclosure type
 - 3. Ampere rating

PART 2 - PRODUCTS

2.01 CONSTRUCTION

- A. Provide safety switches appropriately rated for use with electrical system 600 Vac for 480 volts, 250 Vac for 208 volts and etc.
- B. Provide safety switches NEMA Standard KS1 for type HD (heavy duty), and horsepower rated for A/C motors.
- C. Switches requiring fuses and rated 600 amps and below shall be provided with rejection clips. Switches rated larger than 600 amps shall have Class "L" fuse connections provided.
- D. Provide safety switches in NEMA 1 enclosure located on the interior dry locations. Provide safety switches in NEMA 3R enclosure located on the exterior of the building or in wet locations.

- E. Provide quick-make and quick-break operating handle. Provide mechanisms which are an integral part of the box. Furnish a handle suitable for padlocking in the ON and OFF positions with a padlock of 5/16-inch diameter shank.
- F. Door Interlock. Furnish a door interlock to prevent opening the door when the switch is in the ON position, unless bypassed, and to prevent turning the switch ON when the door is open.
- G. Bypass Interlock. Furnish an external means to bypass the door interlock.
- H. Terminal Shield. Furnish incoming line terminals with an insulated shield so that live parts are not exposed when the door is open.
- I. Neutral. Where neutrals are indicated furnish switches with an isolated, fully rated neutral block. Make provisions for bonding the block to switch enclosure.
- J. Equipment Grounding. Furnish an equipment grounding kit.
- K. Fuse Holders. Where fusible switches are indicated, furnish switches with rejection-type fuse holders and fuses conforming to Section 16490, Fuses - 600 Volt and Below.
- L. Auxiliary Contacts. Where switches are shown for elevator service, furnish switches with two DPST auxiliary contacts.
- M. Provide lugs U.L. listed for copper cable.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Securely mount safety switches in accordance with the N.E.C. Provide all mounting materials and mount safety switches vertically.
- B. In general, safety switches must be mounted on an independent and separate support system, not on the equipment being served. Where such an independent support would require penetrating or resting on a roof, it is preferable to mount on the equipment. In no case, however, may the switch interfere with access to or operation of the equipment, nor shall the switch be located within the significant impact zone of a flue or other high temperature component. Where screen walls are provided for outdoor units; the top of disconnect shall be below or equal to the top of screen wall.
- C. Coordinate final location of disconnect switches to provide a minimum of 36" clear in front of switch. Conduit may not be routed in access clear directly in front of disconnect switch.
- D. Install switches for all equipment that requires them. Mount so that operating handle is approximately 60 inches above finished floor. Where grouped, align tops of switches.
- E. Disconnects mounted above ceiling must be mounted to be readily accessible near unit. Handle to be no more than 36" above ceiling grid.
- F. All exterior disconnects to be mounted below line of sight of a screen wall or if single disconnects, level with top of condenser. Verify location with Architect/Engineer prior to rough-in.

END OF SECTION

SECTION 26 28 16 - FUSES

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Provide and install fuses as shown on the Drawings and as hereinafter specified.

1.02 STANDARDS

- A. Conform with the latest requirements of the National Electrical Code, NEMA and be UL listed.

1.03 ACCEPTABLE MANUFACTURERS

- A. Bussman
- B. Gould
- C. Little Fuse

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Time Delay/Dual Element (Class R) fuses 1/10 through 600 amps.
- B. Time Delay/Dual Element (Class RK5) fuses 1/10 through 200 amps for mechanical equipment and where noted.
- C. Time Delay (Class L) fuses 601 - 6000 amps.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

- A. Fuses shall not be installed until equipment is ready to be energized.
- B. Test and inspection shall be made prior to energization of the equipment. This shall include a thorough cleaning, tightening and review of all electrical connections and inspection of all grounding conductors.
- C. All fuses shall be furnished and installed by the Electrical Contractor.
- D. All fuses shall be of the same manufacturer.
- E. Equipment Fuses: Verify final fuse size with actual equipment being installed. Do not exceed permitted fuse size and voltage of manufacturer ratings.

3.02 INSTALLATION

A. Mains, Feeders and Branch Circuits:

1. Circuit 0 to 600 amperes shall be protected by current limiting dual-element, time delay fuses. All dual-element fuses shall have separate overload and short-circuit elements. The fuse must hold 500% of rated current for a minimum of ten (10) seconds, with an interrupting rating of 200,000 amperes r.m.s. symmetrical. The fuses shall be UL Class RK-1 (or RK-5 where specifically permitted). They shall be marked with the proper fuse rating, per the specifications, and placed in a conspicuous location on the enclosure.
2. Circuits 601 to 6000 amperes shall be protected by current limiting time delay fuses. Fuse link shall be pure silver links (99.9% pure), to limit the short circuit current let through valves to low levels and comply with NEC Sections requiring component protection. Fuses shall be time-delay and must hold 500% of rated current for a minimum of four (4) seconds with an interrupting rating of 200,000 amperes r.m.s. symmetrical. The fuses shall be UL Class L. "CAUTION" labels to alert the end user of engineered level of protection of the electrical equipment, shall be field installed by the Electrical Contractor. They shall be marked with the proper fuse rating, per the specifications, and placed in a conspicuous location on the enclosure.
3. Motor Circuits - All individual motors rated for 200 horsepower or less shall be protected by time delay/dual-element fuses. The fuses for motors shall be installed in ratings approximately 125% of motor full load current, except where high ambient temperatures prevail, or where the motor drives a heavy revolving part which cannot be brought up to a full speed quickly, such as large fans. Motors shall be protected by fuses of the rating shown on the Drawings. The fuses shall be UL Class RK-1 (or RK-5 where specifically permitted) Dual Element/Time Delay. "CAUTION" labels to alert the end user of the engineered level of protection of the electrical equipment shall be field installed by the Electrical Contractor. They shall be marked with the proper fuse rating, per the specifications, and placed in a conspicuous location on the enclosure.

B. Spares:

1. Upon completion of the building, the Contractor shall provide the Owner with spare fuses in cabinet as identified in Specification Section 26 05 00.

END OF SECTION

SECTION 26 28 20 - COMBINATION MOTOR STARTERS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Provide full voltage combination starters utilizing fused switches where required by NEC and herein specified.
- B. Provide motor starters when not provided by Division 15.
- C. A combination type (switch-starter) controller shall be provided for locations which are not in sight of a starter's branch circuit disconnecting means.
- D. A horsepower rated, manual motor starter shall be permitted for stationary motors rated at 2 horsepower or less and 300 volts or less.

1.02 STANDARD

- A. UL listed.
- B. Conform to the latest NEMA standards.

1.03 ACCEPTABLE MANUFACTURERS

- A. Square D
- B. ITE Siemens
- C. Cutler Hammer/Westinghouse
- D. General Electric

1.04 SUBMITTALS

- A. Furnish Engineer shop submittal for each starter size, type and enclosure type.
- B. Provide shop submittals which include the following information:
 - 1. Starter size as rated by NEMA.
 - 2. NEMA enclosure type.
 - 3. Number of auxiliary contacts.
 - 4. Switch ratings.
 - 5. Manufacturer catalog numbers.
 - 6. Other descriptive data as may be required.
 - 7. Power monitors.

PART 2 - PRODUCTS

2.01 GENERAL: MOTOR STARTERS TO CONFORM TO THE FOLLOWING:

- A. Magnetically held, full-voltage and non-reversing.
- B. Replaceable, totally enclosed, double break contacts of silver alloy.
- C. Required to open all conductors to the motor.
- D. Auxiliary contacts to perform the required functions.
- E. Replaceable, encapsulated coil suitable for continuous operation at 120 volts, 60 hertz.
- F. Solid state overload relay with; Adjustable trip current setting, selectable tripping time (class) of quick (class 10) and 7 seconds (class 20), phase loss protection, selectable automatic or manual reset, ground fault tripping, visible trip indication, ambient insensitivity.
- G. Control transformer with a 120-volt secondary.
 - 1. Manufacturer's standard size transformer unless otherwise indicated.
 - 2. Fuse both primary lines of the transformer and connect to Line 1 and Line 2. Fuse the secondary line leaving transformer terminal X1. Ground the secondary line leaving terminal X2. Coordinate primary fuses with secondary fuse to clear a faulted transformer but not blow on magnetizing inrush current. Furnish fuses conforming to Section 16490, Fuses - 600 Volt and below.
- H. NEMA 1 enclosures for indoor dry locations, and NEMA 3R enclosures for all outdoor or interior wet or damp locations and NEMA 4x enclosures where exposed to corrosive atmosphere, unless otherwise indicated.
- I. Hand-Off-Auto Selector Switch: Heavy-duty, oil-tight, maintained contact, with marked nameplate.
- J. Start Pushbutton Unit: Heavy-duty, oil-tight, momentary contact, spring return, or maintained contact with marked nameplate.
- K. LED Indicating Light Modules:
 - 1. Pilot light assemblies shall be heavy-duty and oil-tight.
 - 2. Provide a red (run) lens.
 - 3. Provide a green (stop) lens.
 - 4. On two-speed starters, provide amber (low speed), red (high speed) and green (stop) lenses.

2.02 COMBINATION SWITCH-STARTERS MUST CONFORM TO THE FOLLOWING:

- A. Magnetic motor starter as specified herein.
- B. Switches conforming to NEMA Standard KS 1 for Type HD (heavy duty).
- C. Switches with quick-make, quick-break contacts.

- D. 3-pole, visible blade switches, unless otherwise indicated.
- E. Rejection-type fuse-holders with fuses conforming to Section 16490.
- F. Horsepower rated for or above the connected load.
- G. Operating handle suitable for padlocking in the ON and OFF positions with a padlock of 5/16-inch diameter shank.
- H. Door interlock to prevent opening the door when the switch is in the ON position, unless bypassed, and to prevent turning the switch ON when the door is open.
- I. External means to bypass the door interlock.
- J. Equipment grounding kit.
- K. NEMA I enclosures for indoor dry locations and NEMA 3R enclosures for all outdoor or interior wet or damp locations, unless otherwise indicated.

2.03 MANUAL MOTOR STARTERS MUST CONFORM TO THE FOLLOWING:

- A. Line voltage type.
- B. Bimetallic thermal overload protection in each ungrounded phase leg.
- C. Toggle-operated.
- D. NEMA 1 enclosure for indoor dry locations and NEMA 3R enclosures for all outdoor or interior wet or damp locations, unless otherwise indicated.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Securely mount combination starters in accordance with the NEC. Provide all mounting hardware.
- B. Size overload relays according to manufacturer's recommendation for horsepower and KVA code of the motor to be started.
- C. Provide nameplates as described in Section 16010, 3.09.
- D. POWER MONITORS for three phase motors (5HP and larger) shall be protected against single phasing by the addition of power monitors to the control circuits. Power monitors shall be Time Mark Model No. 258 or approved equal. Include in submittals.
- E. In general, combination starters must be mounted on an independent and separate support system, not on the equipment being served. Where such an independent support would require penetrating or resting on a roof, it is preferable to mount on the equipment. In no case, however, may the switch interfere with access to or operation of the equipment, nor shall the switch be located within the significant impact zone of a flue or other high temperature component.
 - 1. Install non-combination units so that the control device is approximately 54 inches above finished floor.

2. Install combination units so that operating handle is approximately 60 inches above finished floor.
 3. Where grouped, align tops of all units.
- F. The electrical contractor will be responsible for all electrical connections to motor starters, no matter who provided the starter.
- G. Initial Settings:
1. Trip current setting:
 - a. Continuous duty motors with a temperature rise of 40 degree or less and a service factor of 1.15 or more shall be set at no greater than 125% of the motor's full load current rating. When the initial setting is not sufficient to start the motor or to carry the load, settings may be increased from 125% up to 140%.
 - b. All other continuous duty motors shall be set at no greater than 115% of the motor's full load current rating. When the initial setting is not sufficient to start the motor or to carry the load, settings may be increased from 115% up to 130%.
 2. Trip class setting:
 - a. Class 10 (quick) for hermetically sealed (AC compressors), submersible pumps and motors which have a low ratio of locked rotor to full load current.
 - b. Class 20 (7 seconds) for motors with normal acceleration.
 3. Manual reset mode.
- H. Record all overload settings and motor data, reference specification section 'Manual Motor Starter – 26 28 10'.

END OF SECTION

SECTION 26 28 25 – CONTACTORS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Provide lighting contactors as shown on the drawings and as hereinafter specified.

1.02 STANDARDS

- A. Approved per UL 508 and designed in accordance with NFPA 1C52-211B.
- B. UL listed.
- C. Conform to the latest NEMA Standards.

1.03 ACCEPTABLE MANUFACTURERS

- A. Square D
- B. ITE Siemens
- C. Cutler Hammer/Westinghouse
- D. General Electric

1.04 SUBMITTALS

- A. Furnish Engineer shop submittals for contactors.
- B. Provide shop submittal which includes the following information:
 - 1. Voltage and ampere rating
 - 2. Wiring diagram
 - 3. Enclosure type
 - 4. Coil voltage

PART 2 - PRODUCTS

2.01 GENERAL

- A. Continuously current rated.
- B. Capable of making and breaking all cases of loads without the aid of auxiliary arcing contacts. Auxiliary arcing contacts are not acceptable.
- C. Industrial duty rated for applications to 600 volts maximum.

2.02 MATERIALS

- A. Totally closed, double break, silver to silver power contacts. Contact inspection and replacement shall be possible without disturbing line or load wiring.
- B. Provide terminals with straight through wiring and accept copper wire.
- C. Provide switches or provisions for switches as indicated on the drawings.
- D. Unless otherwise indicated, provide contactor in NEMA Type 1 enclosure.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Securely mount lighting contactor. Provide all mounting hardware.

END OF SECTION

SECTION 26 41 13 - LIGHTNING PROTECTION SYSTEM

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish and install all equipment, accessories, and material required for the installation of a complete Master labeled UL, AW, IRI approved Lightning Protection System in accordance with the specifications. Any material and/or equipment necessary for the proper operation of the system not specified or described herein shall be deemed part of this specification.
- B. The equipment described and furnished under these specifications shall be the standard product of one manufacturer.

1.02 STANDARDS

- A. Construct each item of equipment, including parts and accessories, in a workmanlike manner, using new materials or the best quality obtainable for the purpose intended. Design and build materials, wiring and equipment in accordance with the best practices of the electrical industry.
- B. Furnish and install a complete Lightning Protection System which shall comply with the specifications of the Underwriters' Laboratories (UL 96A), the National Fire Protection Association (NFPA No. 78) and the Lightning Protection Institute (LPI-75). The Underwriter's Laboratories Master Label "C" shall be delivered to the Architect/Engineer for approval before installation is completed.

1.03 QUALIFICATIONS

- A. Manufacturer: Company specializing in lightning protection equipment with minimum three years documented experience and member of the Lightning Protection Institute.
- B. Installer: Authorized installer of manufacturer with three years documented experience and member of the Lightning Protection Institute.

1.04 SUBMITTALS

- A. Furnish the Engineer Shop Drawings/Submittals for each of the following:
 - 1. Submit 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 terminal details.
 - 2. Submit product data showing dimensions and materials of each component and include indication of listing in accordance with ANSI/UL 96.
 - 3. Complete manufacturer's installation documentation.

1.05 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of air terminals, grounding electrodes, bonding connections and routing of system conductors.

PART 2 – PRODUCTS

2.01 PRODUCTS

- A. Components - Including but not limited to: (In accordance with ANSI/UL 96)
 - 1. Air Terminals
 - 2. Grounding Plate
 - 3. Conductors
 - 4. Connectors and Splicers
- B. Materials shall be as required by code to suit installation requirement including materials of mounting surfaces.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. All metal bodies such as ventilators, stacks, pipes, gutters, downspouts, ducts, tracks, antennas, water pipes, ladders, exercise yard cover and other similar metal shall be interconnected to the main conductor system.
- B. Incoming electric and telephone service shall have a common ground with the Lightning Protection System.
- C. **Obtain the services of Underwriters Laboratories, Inc. to provide inspection and certification of the lightning protection system under provisions of UL 96A.**
- D. No part of the system shall be concealed until inspected. In addition, the Underwriter's Laboratories Master Label "C" shall be delivered to the Architect or Owner before the completed installation is cleared for final payment. Any items found not to comply with the specification requirements shall be immediately replaced at no additional cost to the Owner.
- E. The system shall be installed by an authorized installer.
- F. All materials shall be copper, except where specifically prohibited by UL96A due to materials of mounting surfaces which may cause deterioration in the presence of moisture. At these locations use appropriate material.

END OF SECTION

SECTION 26 43 00 - SURGE PROTECTIVE DEVICES (SPDs)

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Provide a complete grounding system in strict accordance with Article 250 of the National Electrical Code and as hereinafter specified and shown on the Drawings.

PART 2 – PRODUCTS

2.01 SURGE PROTECTIVE DEVICES (SPDs)

- A. SPD shall be UL 1449 labeled with 200kA Short Circuit Current Rating (SCCR). Fuse ratings shall not be considered in lieu of demonstrated withstand testing of SPD, per NEC 285.6.
- B. SPD shall be UL 1449 labeled as Type 1 intended for use without need for external or supplemental overcurrent controls. Every suppression component of every mode, including N-G, shall be protected by internal overcurrent and thermal overtemperature controls. SPDs relying upon external or supplementary installed safety disconnectors do not meet the intent of this specification.
- C. SPD shall be UL 1449 labeled with 20kA I-nominal (I-n) (verifiable at UL.com) for compliance to UL 96A Lightning Protection Master Label and NFPA 780.
- D. Standard 7 Mode Protection paths: SPD shall provide surge current paths for all modes of protection: L-N, L-G, L-L, and N-G for Wye systems; L-L, L-G in Delta and impedance grounded Wye systems.
- E. True 10 Mode Protection paths: SPD shall provide “directly connected protection elements” between all possible modes of protection: L-N, L-G, L-L, and N-G for Wye systems; L-L, L-G in Delta and impedance grounded Wye systems.
- F. Maintenance: Provide SPDs with a serviceable replaceable module, with indicator lights for normal and faulted conditions. Provide audible alarm and visual status indicators to indicate need for renewal or replacement. Provide units which are UL listed for installation in accessible areas.
- G. Disconnecting Means: If a dedicated breaker for the SPD is not provided in the switchboard, the service entrance SPD shall include an integral UL Recognized disconnect switch. A dedicated breaker shall serve as a means of disconnect for distribution SPD's.
- H. The following styles are defined for determining ratings, installation method, and applications.
 - 1. Service Entrance - SPD shall be exterior to panelboard enclosure, enclosure suitable for same environment as panelboard enclosure, connected to buss through instrument power type of disconnect and protection. Meet UL 1449 4th edition performance parameters. SPD shall be Type 1.
 - 2. Distribution / Branch Panels - SPD shall be exterior to panelboard enclosure, enclosure suitable for same environment as panelboard enclosure, connected through branch circuit breaker in panelboard. Meet UL 1449 4th edition performance parameters. SPD shall be Type 1.

- I. Voltage Protection Ratings : For the applicable voltage configuration the SPDs UL 1449 4th edition Voltage Protection Rating (VPR) in any mode (L-N, L-G, and N_G), shall not exceed the following:

Voltage Configuration	UL 1449 4th Edition VPR Standard or 10-Mode
120 Volt, 1 Phase	700
120/240 Volt, 1 Phase	700
120/208 Volt, 3 Phase Wye	700
240 Volt, 1 Phase	1000
240 Volt, 3 Phase Delta	1200
277/480 Volt, 3 Phase Wye	1200
480 Volt, 3 Phase Delta	1800

- J. SPD shall meet or exceed the following criteria:

1. Surge current rating shall be as defined on the plans.
2. Life Cycle Performance Test: SPD shall be tested and pass a minimum of
 - a. Service Entrance SL3 - 30,000 repetitive surge current hits per phase, per IEEE C62.41.2 C3 combination waveform with no more than 10% degradation.
 - b. Service Entrance/Distribution Panel TG3 - 18,000 repetitive surge current hits per phase, per IEEE C62.41.2 C3 combination waveform with no more than 10% degradation.
3. Select – SL3 Selection Requirement: When the #SL3 SPD unit is selected, the following over voltage protection requirements must be met.
 - a. SPD shall be able to prevent common temporary over voltages from damaging the MOVs, increasing longevity and ability of SPD unit to protect the critical load. SPD shall limit the voltage per the following chart:

Overvoltage seen by MOVs as % of Nominal				
	available current			
time	30A	100A	500A	1000A
1 cycle	120%	130%	150%	160%
10 cycles	130%	150%	160%	160%
30 cycles	140%	150%	160%	160%

- b. Temporary Over Voltages: SPD shall be able to withstand a minimum of 100 temporary over voltage events, as defined by: 30A available fault current, 30 cycles of duration, with 10 seconds between events.
- K. Available Manufacturers: Subject to compliance with requirements, manufacturers offering SPDs which may be incorporated in the work included, but are not limited to the following:
1. Basis of Design: Current Technologies by ABB

2. Alt. Manufacture: All substitutions must get prior approval submit as an Alternate with 3rd party test to verify performance matches specification. Performance cannot be reduced to be considered an alternate. Prior Approval is mandatory. Substitute manufacturers shall have products evaluated for acceptability and conformance with the performance requirements of this specification and shall provide detailed compliance and/or exception statements, along with the documentation required in the submittal section, including test documentation (signed by an engineer) confirming that the SPD(s) meets the specified performance. Alternate manufacturer must fill out the "Substitution Request" form found in the General electrical specification section, "Alternate Manufacturer Information Sheet" in this section and show compliance to all parts of this specification.
 3. Substitutions not following substitution requirements outlined in the General electrical section and criteria outlined in this specification in (2) above will not be considered. When substitution information doesn't follow specification format or is unclear, which causes additional substantial Engineer review time, review time spent may be billed to Contractor at current Engineer hourly rates.
- L. Warranty: Manufacturer agrees to repair or replace SPDs that have been started up and inspected per 3.02.A which fail in materials or workmanship within specified warranty period.
1. Warranty Period: Twenty (20) years from date of Substantial Completion.

PART 3 – EXECUTION

3.01 INSTALLATION OF SURGE PROTECTIVE DEVICES (SPDs)

- A. General: Install surge arrestors where indicated. Follow the manufacturer's instruction and NEC Article 285 for installation on line or load side of services.
- B. Limit the length of tap conductors to the least length practicable. In no case extend unprotected tap conductors more than ten (10) feet, or beyond the enclosure of the panelboard, switchboard or disconnect served.
- C. Upon completion of installation, provide the start-up and testing services of a factory-authorized and factory-trained local service representative. A member of the engineer's office or a representative of SWMCO, service@swmco.com shall be required for performing and witnessing of the tests. The tests shall include:
 1. Off-line Testing: Impulse injection to verify the system tolerances as well as verification of proper facility neutral-to-ground bond. Compare field test results to factory benchmark test parameters supplied with each individual unit.
 2. On-line Testing: Verify that suppression and filtering paths are operating with 100% protection as well as verification of proper facility neutral-to-ground bond by measuring neutral-to-ground current and voltage and by visual inspection.
 3. Voltage measurements from Line-to-Ground (L-G), Line-to-Neutral (L-N), Line-to-Line (L-L), and Neutral-to-Ground (N-G), taken at the time of the testing procedure.

3.02 DOCUMENTATION AND REPORTING

- A. Record results of field testing and compare to factory benchmark test parameters supplied with each individual surge protective device. Indicate that the integrity of neutral-to-ground bonds were verified through testing and visual inspection, and that grounding bonds were observed to be in place.

- B. Submit to the Owner's representative and to the Architect/Engineer copies of the startup test results and the factory benchmark testing results for confirmation of proper suppression filter system function, as required by this section. Provide the number of copies as required by Division One and the Electrical General Provisions section; and three copies where not otherwise specified.

Surge Protection: _____ PROJECT NAME _____
(Manufacturer to fill out entire form for Alternate Only)

1. Surge Alternate Manufacturer Name: _____

2. Model Numbers for:

a. "MSB":

Model: _____

b. Panels _____:

Model: _____

b. Panels _____:

Model: _____

3. Does MSB Surge have Advance Monitoring ____ Yes ____ No

(Advanced Monitoring: Voltmeter, Surge Counter, Event Logger)

Attached specification sheet on monitor ____ Yes ____ No

4. Does MSB have Over-Voltage Protection ____ Yes ____ No

5. Surge ratings:

a. Model _____ Rating _____

b. Model _____ Rating _____

c. Model _____ Rating _____

6. Testing

a. Have units been tested for Surge Impulse Surge Current by a third-party independent laboratory? ____ Yes ____ No

b. Attached 3rd party Test Report ____ Yes ____ No

c. Can SPD be tested in field and compared to factory test ____ Yes ____ No

7. Warranty Period

a. Standard Warranty _____ Years

b. Life Expectancy _____ Years

END OF SECTION

SECTION 26 51 00 - INTERIOR LIGHTING SYSTEM

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Provide all lighting fixtures and equipment as specified in the fixture schedule. Include all necessary accessories and appurtenances required for a complete and operating system whether or not specifically shown. **Fixture performance/lumen output must meet or exceed performance/lumen output specified in the light fixture schedule.**
- B. Electrical contractor shall confirm all fixture driver voltage ratings match the project electrical power system lighting circuit voltage prior to submittal and order of fixtures. If fixtures are to be connected to existing lighting circuits, contractor shall field verify the existing circuit voltage prior to submittal and order of site fixtures. Any drivers that need to be replaced after delivery due to incorrect voltage will be at the contractor's expense.

1.02 STANDARD

- A. Provide all materials and accessories, whether specifically described or not, of the best grade of the commercial manufacturer. Provide first class workmanship in every respect.
- B. Provide all lighting fixtures with Underwriters' label and manufacturer's label. Attachment of U.L. labels after delivery of fixtures is not acceptable.
- C. Manufacture all lighting fixtures in accordance with the National Electrical Code.

1.03 ACCEPTABLE LIGHTING AND LIGHTING CONTROL PACKAGES:

- A. Base Bid: Lithonia (Controls – Acuity nLight Series)
- B. Base Bid: Others Fixtures as Scheduled or Noted (Controls – Acuity nLight Series)

The following manufacturers shall be quoted as an Alternate Bid:

- C. Signify (Controls – Leviton GreenMAX DRC Controls)
- D. Hubbell (Controls – Hubbell NX Series)

1.04 SUBMITTALS

- A. Furnish Engineer shop drawings for each fixture.
- B. Provide shop drawing which includes the following information:
 - 1. Fixture type per the fixture schedule.
 - 2. Manufacturer of the fixture.
 - 3. Physical dimensions of the fixture.
 - 4. Manufacturer's standard finish.
 - 5. Fixture output distribution curves with utilization parameters.

6. Driver temperature rating, voltage, wattage, and manufacturer.
 7. Material type and thickness of lens.
 8. Accessories for installation such as swivel hangers.
 9. Efficacy (lumens/watt).
- C. Submit point-by-point lighting calculations for each space type as required by the specifications or noted on the drawings. The calculations shall include Light Loss Factor of 0.9. The calculations shall indicate maintained horizontal footcandle levels at a height of thirty inches above the floor. In interior spaces the maximum point spacing shall be five feet on center; for outdoor applications the maximum point spacing shall be 30 feet on center unless otherwise noted on the drawings.
- D. Working samples of all substitutions, if requested: Samples shall be 120 volt with cord and plug attached and shall include specified LEDs and all modifications necessary to meet the requirements specified in the Contract Documents.
- E. Lighting Control Submittal
1. Shop Drawing Floorplan drawings at 1/8" scale showing
 - a. Motion sensor layout as directed on plans
 - b. Daylight sensor layout as directed on plans
 - c. Identify enabled fixtures
 - d. Identify power packs
 - e. Identify power pack location for open ceiling areas (above panel in electrical room)
 2. Symbol legend identifying symbols
 3. Control sequences
 4. Riser diagrams showing low voltage cabling requirements
 5. Cutsheets of all parts

1.05 PRODUCTS STORAGE AND HANDLING

- A. Protect fixtures delivered to the job site from the entrance of water and dust at all times. Replace fixtures damaged by improper handling or storage.

1.06 COORDINATION

- A. Catalog numbers shown on the light fixture schedule may not include or adequately represent all the options and accessories required herein, this contractor shall conform to these specifications in their entirety.
- B. The various ceiling types are indicated on the architectural plans and in the room finish schedules. All lighting fixtures shall be coordinated with the architectural requirements to ensure that the proper trim kit, and/or mounting accessory is provided with each fixture for the intended application. All trim kits and accessories shall be provided by Contractor whether or not they are specifically indicated by the manufacturer's catalog numbers on the lighting fixture schedule.

- C. The locations of all lighting fixtures are approximate. Locations are subject to modifications at the time of installation in order to meet field conditions. Make such changes without extra charge; however, obtain approval from Engineer before any work is started which involves such modifications.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Provide all fixtures as called for in the schedules.
- B. Provide manufacturer's standard finish unless otherwise noted.
- C. Design all recessed or semi-recessed fixtures compatible with ceilings as installed. Provide frames where required for proper installation.
- D. Furnish complete, all fixtures requiring end caps, mounting spacers or other necessary items whether the catalog number shown includes such items or not.
- E. Conceal all fixture parts within the fixture construction.
- F. Self-locking lenses/latches are not acceptable.**
- G. Lighting fixture construction shall effectively eliminate light leaks between the frame, lens, housing and the interior finish surface. Furnish one lens hold-down clip at two-foot centers.
- H. Conceal all fixture parts, including emergency components, within the fixture construction.
- I. Fixture construction shall allow parts and lens to be replaced without special tooling.
- J. Fixture shall be provided with disconnecting means per current NEC.

2.02 EMERGENCY EXIT LIGHTS

- A. Exit lights must conform to the following:
 - 1. Furnish a system consisting of a sealed rechargeable maintenance-free nickel cadmium battery, battery charger, solid state inverter, test switch, and pilot light.
 - 2. Meet or exceed the current NFPA requirements.
 - 3. Light emitting diode (LED) type.
 - 4. Die-cast aluminum.
 - 5. Concealed and removable directional chevron knock-outs.
 - 6. Stencil face.
 - 7. Red letter color.
- B. Label power packs, using a black marking pen, with the identity of the un-switched circuit.

2.03 LED LIGHT FIXTURE

- A. Each luminaire shall be designed to operate at an average operating temperature of 25°C.
- B. The operating temperature range shall be 0°C to +25°C.
- C. Each luminaire shall meet all parameters of this specification throughout the minimum operational life when operated at the average operating temperature.
- D. Power supplies must use Constant Current Reduction (CCR) for dimming.
- E. LED lamps shall have a color rendering index (CRI) of 80 or greater and a color temperature of 3500 Kelvin for interior fixtures and 4000 Kelvin for exterior fixtures or as specified on drawings.
- F. Lumen output shall not decrease by more than 30% over the minimum operational life of 60,000 hours.
- G. Individual LEDs shall be connected such that a catastrophic loss or the failure of one LED will not result in the loss of the entire luminaire.
- H. The luminaire shall operate from a 50 or 60 Hz ± 3 Hz AC line over a voltage ranging from 120 VAC to 277 VAC. The fluctuations of line voltage shall have no visible effect on the luminous output. The standard operating voltages are 120 VAC, 277 VAC, 347 VAC and 480VAC.
- I. Electrical connections between normal power and driver must be modular utilizing a snap fit connector. All electrical components must be easily accessible after installation and be replaceable without removing the fixture from the ceiling.

2.04 DRIVERS

- A. Ten-year expected life while operating at maximum case temperature and 90 percent non-condensing relative humidity.
- B. Driver shall be UL Recognized under the component program and shall be modular for simple field replacement. Drivers that do not meet these requirements will not be accepted.
- C. Electrical characteristics: 120 - 277 volt, UL Listed, CSA Certified, Sound Rated A+. Driver shall be > 80% efficient at full load across all input voltages. Input wires shall be 18AWG solid copper minimum.
- D. Dimming: Driver shall be suitable for full-range dimming. LED dimming shall be equal in range and quality to a commercial grade incandescent dimmer. Quality of dimming to be defined by dimming range, freedom from perceived flicker or visible stroboscopic flicker, smooth and continuous change in level (no visible steps in transitions), natural square law response to control input, inaudible in 26db environment, and stable when input voltage conditions fluctuate over what is typically experienced in a commercial environment. Demonstration of this compliance to dimming performance will be necessary for substitutions or prior approval.
- E. The luminaire shall be capable of continuous dimming without perceivable flicker over a range of 100 – 10%, 100 – 1.0% or 100 – 0.1% of rated lumen output as specified in light fixture schedule with a smooth shut off function to step to 0%.
- F. Control Input
 - 1. 4-Wire (0-10V DC Voltage Controlled) Dimming Drivers

2. Digital (DALI Low Voltage Controlled) Dimming Drivers
 3. Digital Multiplex (DMX Low Voltage Controlled) Dimming Drivers
- G. Driver disconnect shall be provided where required to comply with codes.
- H. The electronics/power supply enclosure shall be internal to the SSL luminaire and be accessible per UL requirements.
- I. The surge protection which resides within the driver shall protect the luminaire from damage and failure for transient voltages and currents as defined in ANSI/IEEE C64.41 2002 for Location Category A, where failure does not mean a momentary loss of light during the transient event.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Set luminaires true, free of light leaks, warps, dents or other irregularities. Provide the length of stems as required to hang all luminaires level and in the same plane. **VERIFY THE TYPE OF ALL CEILINGS BEFORE ORDERING FIXTURES AND PROVIDE FIXTURES AND MOUNTINGS TO SUIT.** Mount all fixtures at a position and height to clear equipment, ductwork, piping, etc., in mechanical rooms, storage rooms, etc. Provide appurtenances for all light fixtures, which include stud supports, stems, mounting brackets, frames and plaster rings.
- B. Support luminaires only from structural elements which are capable of carrying the total weight. Mount all lighting fixtures rigid with no rocking action. Provide 13/16" channels as needed.
- C. The locations of all lighting fixtures as shown are approximate. It is understood that they are subject to such modifications as may be found necessary or desirable at the time of installation in order to meet field conditions. Make such changes without extra charge; however, obtain approval from Engineer before any work is started which involves such modifications.
- D. Install drivers and fixtures in accordance with the NEC and ANSI Standards.
- E. Adjust all floodlights and spotlights to the satisfaction of the Engineer.
- F. Connect all exit lighting fixtures to the nearest unswitched circuit or the nearest emergency circuit. Connect all emergency lighting fixtures to same circuit as normal area lighting in same area per NEC Article 700.
- G. Provide all exit signs with required directional arrows, to indicate direction of egress travel.
- H. Fixtures shall NOT be daisy chained together.**
- I. Troffer (lay-in) lighting fixtures shall be supported from the building structure by a minimum 12 gage galvanized carbon steel soft temper hanger wires. Install two hangers at diagonally opposite corners of each lay-in light fixture 2'x4' or smaller and one hanger at each corner of each lay-in light fixture larger than 2'x4'. Supporting of light fixtures from ceiling system is not acceptable.
- J. Each recessed lighting fixture shall be separately connected to a junction box with a flexible wiring method (i.e. daisy chaining from fixture to fixture is not allowed). The flexible conduit from the junction box to the fixture shall not lay on the ceiling as finally installed and shall not exceed 6 feet in length.

- K. Boxes to which light fixtures or pendants are mounted shall NOT contain any conductors foreign to the operation of such light or pendant application. Removal of lights, pendants and cord drops to access other branch circuits is NOT acceptable.
- L. Pendant mounted light fixtures shall be provided with $\frac{3}{4}$ " threaded, rigid metal conduit, painted to match the fixture color.
- M. Install flush mounted fixtures properly to eliminate light leakage between fixture frame and finished surface, provide gaskets as needed.
- N. Install high or low bay light fixtures between the joist with the bottom of the reflector flush with the bottom cord of the joist. Engineer will direct if obstructions such as ducts, beams, etc. are permanently installed below the joist.
- O. Locate mechanical, electrical, equipment, etc. room light fixtures to provide the best coverage and clear all obstructions such as ducts, piping, bracing and supports.
- P. High Bay lights are to be rigidly mounted with all thread, $\frac{3}{4}$ " threaded rigid metal conduit and unistrut or suspended from aircraft cable as noted on plans.

3.02 CLEAN UP

- A. Leave all fixtures in clean condition, free of dirt and defects.

END OF SECTION

SECTION 26 56 00 - EXTERIOR LIGHTING SYSTEM

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Provide all exterior lighting fixtures and equipment as specified in the fixture schedule. Include all necessary accessories and appurtenances required for a complete and operating system whether or not specifically shown. Exterior lights shall be circuited through lighting contactor for time clock/photocell control.
- B. Electrical contractor shall confirm all site fixture driver voltage ratings match the project electrical power system voltage and site lighting circuit voltage prior to submittal and order of site fixtures. If site fixtures are to be connected to existing site lighting circuits, contractor shall field verify the existing circuit voltage prior to submittal and order of site fixtures. Any drivers that need to be replaced after delivery due to incorrect voltage will be at the contractor's expense.

1.02 STANDARDS

- A. Provide all materials and accessories, whether specifically described or not, of the best grade of commercial manufacturer. Provide first class workmanship in every respect.
- B. Provide all lighting fixtures with Underwriters' label and manufacturer's label. Attachment of U.L. labels after delivery of fixtures will not be acceptable.
- C. Manufacture lighting fixtures in accordance with the National Electrical Code.
- D. Provide lamps manufactured by North American Phillips or Sylvania. Unless otherwise indicated, lamp designations shown on the fixture schedule are Sylvania.

1.03 ACCEPTABLE LIGHTING PACKAGES:

- A. Base Bid: Lithonia
- B. Base Bid: Others Fixtures as Scheduled or Noted

The following manufacturers shall be quoted as an Alternate Bid:

- C. Signify
- D. Hubbell

1.04 SUBMITTALS

- A. Furnish Engineer shop drawings for each fixture.
- B. Provide shop drawing which includes the following information:
 - 1. Fixture type per the fixture schedule
 - 2. Manufacturer of the fixture
 - 3. Physical dimensions of the fixture

4. Manufacturer's standard finish
 5. Lamp type recommended by the manufacturer
 6. Fixture output distribution curves and photometrics
 7. Ballast temperature rating, voltage, wattage, and manufacturer
 8. Material type of lens
- C. Furnish structural engineer with approved shop drawings on pole, post and Bollard light fixtures for purpose of designing fixture base.

1.05 PRODUCT STORAGE AND HANDLING

- A. Protect fixtures delivered to the job site from the entrance of water and dust at all times. Replace fixtures damaged by improper handling or storage.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Provide luminaire complete with the fixture housing, refractor, lamp, and ballast.
- B. Provide type, wattage, and voltage lamp designated on Drawings.
- C. Where indicated on Drawings, provide parking lot poles and floodlight poles.

2.02 LED LIGHT FIXTURE

- A. Each luminaire shall be designed to operate at an average operating temperature of 25°C.
- B. The operating temperature range shall be 0°C to +25°C.
- C. Each luminaire shall meet all parameters of this specification throughout the minimum operational life when operated at the average operating temperature.
- D. Power supplies must use Constant Current Reduction (CCR) for dimming where dimming is specified.
- E. LED lamps shall have a color rendering index (CRI) of 80 or greater and a color temperature of 4000 Kelvin for exterior fixtures or as specified on drawings.
- F. Lumen output shall not decrease by more than 30% over the minimum operational life of 60,000 hours.
- G. Individual LEDs shall be connected such that a catastrophic loss or the failure of one LED will not result in the loss of the entire luminaire.
- H. The luminaire shall operate from a 50 or 60 Hz \pm 3 Hz AC line over a voltage ranging from 120 VAC to 277 VAC. The fluctuations of line voltage shall have no visible effect on the luminous output. The standard operating voltages are 120 VAC, 277 VAC, 347 VAC and 480VAC.

- I. Electrical connections between normal power and driver must be modular utilizing a snap fit connector. All electrical components must be easily accessible after installation and be replaceable.

2.03 DRIVERS

- A. Ten-year expected life while operating at maximum case temperature and 90 percent non-condensing relative humidity.
- B. Driver shall be UL Recognized under the component program and shall be modular for simple field replacement. Drivers that do not meet these requirements will not be accepted.
- C. Electrical characteristics: 120 - 277 volt, UL Listed, CSA Certified, Sound Rated A+. Driver shall be > 80% efficient at full load across all input voltages. Input wires shall be 18AWG solid copper minimum.
- D. Dimming (where specified): Driver shall be suitable for full-range dimming. LED dimming shall be equal in range and quality to a commercial grade incandescent dimmer. Quality of dimming to be defined by dimming range, freedom from perceived flicker or visible stroboscopic flicker, smooth and continuous change in level (no visible steps in transitions), natural square law response to control input, inaudible in 26db environment, and stable when input voltage conditions fluctuate over what is typically experienced in a commercial environment. Demonstration of this compliance to dimming performance will be necessary for substitutions or prior approval.
- E. The luminaire shall be capable of continuous dimming (when specified) without perceivable flicker over a range of 100 – 10%, 100 – 1.0% or 100 – 0.1% of rated lumen output as specified in light fixture schedule with a smooth shut off function to step to 0%.
- F. Control Input (when dimming is specified)
 1. 4-Wire (0-10V DC Voltage Controlled) Dimming Drivers
 2. Digital (DALI Low Voltage Controlled) Dimming Drivers
 3. Digital Multiplex (DMX Low Voltage Controlled) Dimming Drivers
- G. Driver disconnect shall be provided where required to comply with codes.
- H. The electronics/power supply enclosure shall be internal to the SSL luminaire and be accessible per UL requirements.
- I. The surge protection which resides within the driver shall protect the luminaire from damage and failure for transient voltages and currents as defined in ANSI/IEEE C64.41 2002 for Location Category A, where failure does not mean a momentary loss of light during the transient event.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Orient lighting fixtures as shown on Drawings.

- B. Wall mounted fixtures shall be mounted flush to the building wall and mounted level in all axes. Where fixtures are mounted to metal panel, the contractor shall provide all materials required for a solid structural mounting surface inside the metal panel for securing the weight of the fixture and provide all necessary trim and flashing to have a flush mounted finished appearance with sealed penetrations. Fixtures mounted directly to metal panel that do not meet the description above will be rejected. All modifications required to suit the description above will be performed at the contractor's expense.
- C. Adjust all floodlights and spotlights to the satisfaction of the Engineer.
- D. Coordinate exact location of lighting fixtures with Architect prior to rough-in.

3.02 CLEAN UP

- A. Leave all fixtures and poles in clean condition, free of dirt and defects.

END OF SECTION

SECTION 26 99 95 – COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 COMMISSIONING AGENCY

- A. The Commissioning Agency (CA) has been contracted directly with the owner for this project.
- B. The CA has overall responsibility for planning and coordinating the HVAC commissioning process. However commissioning involves all parties to the design and construction process, including the electrical (Division 26) contractor, as many HVAC system components require electrical power and controls in order to operate as specified.

1.02 CONTRACTOR RESPONSIBILITY

- A. The electrical (Division 26) contractor shall be available as needed to confirm items and perform function test pertinent to commissioning when specified as part of the job.
- B. Lighting Controls
 - 1. Interior and Exterior
- C. Provide Start-up Report
 - 1. Lighting Controls
 - 2. Surge Protective Devices
 - 3. Transformers.
- D. Generators and Transfer Switch
 - 1. Provide all things required to provide functional test of entire Generator and ATS system.
- E. Power Feeders, Megger Reading and Lighting Protection
 - 1. Provide copies of forms required in electrical specifications.
 - 2. For any areas of concern, provide additional test as needed to confirm performance.

END OF SECTION

SECTION 274114 – SOUND REINFORCING SYSTEM

PART 1 GENERAL

1.01 DESCRIPTION OF THE WORK

- A. Equipment and installation for a complete sound reinforcing system in the new church worship center:
- B. Furnishing and installation all equipment and labor as described on the drawings and in these specifications, as needed, to provide complete and working Sound Reinforcing System, as described in the Drawings and Specifications.

1.02 RELATED DOCUMENTS

- A. General Conditions and Requirements, Special Provisions, and applicable portions of Division I of the general contract are hereby made a part of this section.
- B. Architectural, Structural, Mechanical, Electrical, and other applicable documents are considered a part of the Sound System documents insofar as they apply as if referred to in full.

1.03 SCOPE OF THE WORK

- A. These Specifications, together with the related Drawings and General Conditions of the contract, comprise the requirements for the Sound Reinforcing Systems for the project.
- B. Furnish, deliver, erect, install and connect completely all of the material and appliances described herein and in the Drawings, and supply all other incidental material and appliances, tools, transportation, etc., required to make the work complete, and to leave the Audio-Visual Systems in first class operating condition, excluding those items listed under Section 1.10, RELATED WORK IN OTHER SECTIONS.
- C. Perform all assembly of equipment, wiring and inter-connection and soldering of wires to jacks, devices, terminals or equipment, using technical employees only, who are experienced in the installation of Sound System equipment and its inter-connectivity. Coordinate final utility rough-in locations with actual equipment furnished.
- D. Verify dimensions and conditions at the job site prior to installation, and perform installation in accordance with these Specifications, manufacturers' recommendations and all applicable code requirements.
- E. Verify all existing conditions before ordering equipment. Owner shall not be liable for costs associated with return of equipment.

1.04 QUALITY ASSURANCE

- A. The intent of these Specifications is to describe and provide for complete Audio-Visual Systems of high professional quality and reliability. Professional performance standards by the Audio-Visual Systems Contractor (hereafter referred to as Installer) and the equipment will be required.

- B. In all cases, the Owner and Architect shall determine the acceptability of the work based upon the visits, observations, and reports of the Consultant, BAI, LLC of Austin, Texas (hereafter referred to as Consultant).

1.05 SUBSTITUTIONS

- A. Refer to Division 01 for specific substitution procedures and submittal requirements.
- B. Many items are listed in the Specifications by the manufacturer's type or model number, without a detailed performance specification, and may not include the phrase "or approved equal". Where this is the case, no substitutions will be accepted, without a written request from the Installer and the written consent of the Consultant.
- C. Where the phrase "or approved equal" appears, the item specified shall set a standard of quality and performance, based on the published specifications of the manufacturer and on the actual performance as known by the Consultant.
- D. Requests for substitution, when forwarded by the Installer to the Consultant, are understood to mean that the Installer represents that he has personally investigated the proposed substitute product and determined that it is equal to or superior in all respects to that specified, that the same guarantee will be provided for the substitution as for the specified product, and that the Installer will coordinate the installation of the accepted substitute, making such changes as may be required for the work to be complete in all respects.
- E. Substitutions will be considered on the basis of equal performance, only if requested prior to bid date, in writing. No substitutions will be allowed without prior approval.
- F. Substitutions will not be considered if they are indicated or implied in Shop Drawing submissions without previous formal request, or, for their implementation, they require a substantial revision of the Contract Documents in order to accommodate their use
- G. Space allocations and utility rough-ins have been designed on the basis of equipment items named by manufacturer and model number. If any equipment not so named is offered which differs substantially in dimension or configuration from the named equipment, provide scaled shop drawings showing that the substitute can be installed in the space available without interfering with other trades or with access for operation and maintenance in the completed project. The Installer shall coordinate final utility rough-in locations with actual equipment furnished.
- H. Where substitute equipment requiring different arrangement or connections from those shown in the Drawings is accepted by the Consultant, install the equipment to operate properly and in harmony with the intent of the Drawings and Specifications, making all necessary incidental changes without increasing the Contract amount. Pay all additional costs incurred by adjoining or connecting trades.
- I. All requests for substitutions should be submitted before the bid opening date. Substitutions shall be requested and approved in writing only, based upon these criteria. Substitutions requested after bid date will not be considered unless it is determined by the Consultant and Architect that such consideration is in the best interests of the Project.

1.06 INSTALLER QUALIFICATIONS

- A. The work performed under this Section shall be performed by an Audio-Visual Systems contractor, normally engaged in the business of Audio-Visual Systems installation. The prospective contractor

shall show proof, as part of the bid that the contractor has been in the Audio-Visual Systems installation business for a period of not less than five years and has successfully completed projects of similar size and scope.

- B. Each bidder shall hold a current, valid franchise for the major lines of Audio-Visual equipment furnished by them under these Specifications.
- C. All work shall be performed by employees of the sound subcontractor, and not by contract employees. Work crew must be supervised by a technician holding CTS-I certification.
- D. All systems engineering and shop drawings shall be performed by a technician holding a CTS-D certification.
- E. The Owner and Architect reserve the right to reject any bids submitted by firms without sufficient experience in projects of similar size and scope.

1.07 COOPERATION AND COORDINATION

- A. Cooperate and coordinate as required with the other contractors who are responsible for work not included in this section.
- B. Provide any and all information as required or requested by the Owner, Architect, Consultant, or General Contractor in order for this work to be completed to the satisfaction of the Owner, and in the best interests of the Project. Such assistance or information shall be transmitted in writing to the requesting party in all cases. All written correspondence shall be copied to the Consultant.

1.08 GUARANTEE AND WARRANTY

- A. Guarantee all parts, labor, and workmanship furnished under this contract for a period of twelve months from the date of substantial completion.
- B. During the warranty period, report to the site and repair or replace any defective materials or workmanship without cost to the Owner. Warranty service shall be rendered within 48 hours after request by the Owner. Equivalent replacement equipment shall be temporarily provided when immediate on-site repairs cannot be made.
- C. Where warranties on individual pieces of equipment exceed twelve months, the guarantee period shall be extended to the warranty period of the particular items.
- D. Furnish complete and working Audio-Visual Systems. Be of maximum assistance to the Owner during the guarantee period of the system, to the degree that maximum Owner satisfaction is assured.
- E. After completion of the work, the Installer shall submit a Certificate of Warranty, stating commence and expiration dates and conditions of the warranty, for signature of both parties. Incremental warranties for completed portions of the work may be negotiated at the discretion of the Owner, if delays occur beyond the control of the Installer.

1.09 SHOP DRAWINGS AND SUBMITTALS

- A. Completely detailed shop drawings shall be prepared prior to the procurement of equipment or commencement of work. Electronic files of select drawings will be made available to the Installer from the Consultant. A digital files disclaimer shall be signed and returned by the Installer to the Consultant prior to release of such files. The available drawings shall include only: (1) Legend/Power

requirements, (2) Conduit Riser, (3) Floor and Reflected Ceiling Plans, (4) Section Views. Drawings shall be prepared and submitted in electronic format, and as directed by the Architect. Equipment lists, data sheets, etc. shall be 8-½" x 11" size, properly bound into a single electronic format file. Submit in accordance with Division 1, General Requirements.

- B. Within 10 days after the notice to proceed, submit to the Consultant identical copies of the following for approval:
1. A complete equipment list, with manufacturers' names, model numbers, and quantities of each item.
 2. Manufacturers' data sheets on all equipment items.
 3. Equipment rack layouts showing locations of all rack mounted equipment items.
 4. Floor plans and reflected ceiling plans, prepared at a scale of not less than 1/8"=1'-0", showing loudspeaker locations and orientation, junction box and wall plate locations, and all other related device locations.
 5. Proposed construction details for any manufacturer-supplied, third party, and custom fabricated items, including interface panels, patch panels and patchbays, wall plates, speaker mounts and rigging details. These details shall show dimensions, materials, finishes and color selection.
 6. Coordinate with the Architect / Owner regarding color selection of each equipment item and associated mount / mounting hardware for any, and all, exposed devices. Provide factory color options for review in submittal package. The Installer shall request written confirmation from the Architect / Owner on all such devices prior to ordering. Where the Architect's color selection is not a factory color option, the Installer shall coordinate with the device manufacturer for custom color/paint, where available, and, if not available, coordinate with the General Contractor and other trades for field painting.
 7. Comprehensive system schematics, showing detailed connections to all equipment, with wire numbers, terminal block numbers, and color coding.
 8. Riser diagrams showing conduit requirements with pull boxes, outlet boxes, physical cable layouts, part numbers of cable types used, and number of circuits in each conduit.
 9. Electrical power requirements for head-end and ancillary equipment. Include diagrams for any remote control of electrical power, in sufficient detail to coordinate with the electrical contractor, showing exact conduit requirements and locations for power service receptacles.
 10. Certain other submittals as noted elsewhere in this specification, and as may be required for various equipment items prior to construction, fabrication, or finishing of that item.
 11. Submission of the AV Contract Documents / Bid Documents does not constitute a legitimate submittal and will not be accepted.
- C. Incomplete submittals will not be reviewed. Complete Shop Drawings and Product Data shall be submitted as a singular submittal.
- D. All final documentation shall be submitted and approved before final acceptance by the Owner will be granted. Submit the following in accordance with Division 1, General Requirements. The Installer shall provide final documentation in both hard copy and electronic formats. Suitable electronic formats include Microsoft Word and Excel, AutoDesk (.dwg, .dwf), and pdf.
1. A complete as-installed equipment list, listed by room, with manufacturers' names, model numbers, serial numbers, and quantities of each item.
 2. A complete and correct system schematic, showing detailed connections for all parts of the system, including wire numbers, terminal block numbers and layouts, and other designations and codes. System performance measurements as noted elsewhere in this specification shall be documented. Include diagrams or charts showing final settings of all control knobs in the system (mixers, equalizers, power amplifiers, etc.). Submit copies of software settings of each piece of equipment that is software controlled.

3. Network configuration and routing settings for all network-connected equipment in scope including, but not limited to, the following:
 - a. Full IP settings and addressing for each device.
 - b. Network switch configurations, to include settings for VLANs, QoS, DiffServ, IGMP, and any other setting required for proper AV-network performance.
 - c. Configuration and routing parameters for any Audio / AV-over-IP protocol, to include Dante, QLAN, AES67, AVB, Milan, or any other standard protocol, variant, or proprietary communication platform.
4. Complete equipment rack layouts showing locations of all rack mounted equipment items.
5. Floor plans and reflected ceiling plans, prepared at a scale of not less than 1/8"=1'-0", showing loudspeaker locations and orientation, wall plates, rack locations, and other related device locations.
6. Riser diagrams showing as-installed conduit with pull boxes, outlet boxes, physical cable layouts, part numbers of cable types used, and number of circuits in each conduit.
7. Repair parts lists for each and every major equipment item furnished.
8. Manufacturer's warranties and operating instructions for each and every equipment item furnished. Include a copy of the certificate of warranty, signed by both parties.
9. Technical Systems Operations Manual, custom-written by the Contractor, for the purpose of instructing the Owner's operating personnel in the detailed step-by-step operation of the system and preventive maintenance procedures. This manual shall include descriptions of the system components and their relationship to system function. This manual shall be bound separately and labeled appropriately.
10. Incomplete submittals will not be reviewed.

1.10 RELATED WORK IN OTHER SECTIONS

- A. All conduit, raceways, and back boxes. Floor pockets specified herein or on the drawings shall be in this contract, but delivered to the Electrician for installation.
- B. AC Power

PART 2 PRODUCTS

2.01 GENERAL

- A. All items shall be new and unused, unless specifically noted otherwise.
- B. The following sections specifically list the acceptable equipment types and items for this project. Where quantities are not noted, they may be obtained from the Drawings. In the event of a discrepancy between the Specifications and the Drawings, the greater quantity or better quality shall be furnished.
- C. Refer to Section 1.05, SUBSTITUTIONS of this Specification.

2.02 WIRE AND CABLE

- A. Wire not installed in equipment racks, not portable, or not installed in conduit shall be plenum-rated and meet all applicable codes.

- B. Voice coil loudspeaker: West Penn HA212 stranded 12AWG jacketed twisted pair, or approved substitution
- C. Constant voltage (70.7-volt) loudspeaker cable (runs of less than 300 feet): West Penn 225 stranded 16AWG jacketed twisted pair, or approved equal. Provide 25225B Plenum-rated cable, where applicable.
- D. Constant voltage (70.7-volt) loudspeaker cable (runs of 300' to 500'): West Penn 226 stranded 14AWG jacketed twisted pair, or approved equal. Provide 25226B Plenum-rated cable, where applicable.
- E. Constant voltage (70.7-volt) loudspeaker cable (runs of 500' or more): West Penn 227 stranded 12AWG jacketed twisted pair, or approved equal. Provide 25227B Plenum-rated cable, where applicable.
- F. Microphone-level audio cable (installed in conduit, not portable): West Penn Wire 292 stranded 20AWG jacketed twisted pair with foil shield, or approved substitution.
- G. Line-level audio cable and all inter-rack audio cable: West Penn Wire 292 stranded 20AWG jacketed twisted pair with foil shield, or approved substitution.
- H. Wireless microphone antenna cable: Belden 9310, 50-ohm RG-58A/U coaxial cable with Amphenol 50-ohm connectors, or equal. For runs that exceed 50 feet, Belden 9914, 50 ohm RG-8A/U type coaxial cable or approved equal with Amphenol Connex 112563 connectors.
- I. Data wire for AV Control Network: Mohawk Category 6 F/UTP Shielded Cable, or approved equal.
- J. Other equipment control cables shall be stranded wire, appropriately shielded, of gauge and number of conductors required by the manufacturer for proper operation of the system or equipment item furnished.
- K. Wire and cable for all devices shall be supplied in accordance with the recommendations of the device manufacturer and the National Electrical Code.

2.03 JACKS, CONNECTORS, FLOOR BOXES AND WALL PLATES

- A. Provide plates, jacks, and cabling where indicated in the associated AV drawing package.
- B. Furnish and install recessed floor boxes, as identified, at the locations indicated in the drawings.
 - 1. Provide floor box enclosures and construction covers, as applicable, to Division 26 for installation at each location.
 - 2. Provide manufacturer's pour pans, as/if required by mounting location, for each floor box.
 - 3. Boxes shall have a voltage divider or gang box knockout to allow for power receptacles and low-voltage AV connections to reside within the same box, where required. Conduits for high and low voltages must enter box on appropriate side of voltage divider to maintain separation. High and low-voltage wires may not cross within the box.
 - 4. Provide lid / bezel type in accordance with scheduled finished floor type at each location. Finished installation shall provide for all lids flush with associated scheduled floor type. Verify lid types with Architect prior to shop drawings submittal.
 - 5. Verify factory color / finish options for all floor box lid/bezel assemblies with Architect prior to shop drawings submittal. If directed by Architect, paint to match Architect's color sample.

6. Floor box insert connector plates to be provided and installed by Div. 27 41 15. Where insert plate(s) incorporate power receptacle(s), power shall be terminated by Div. 26.
7. Furnish and install the following, or approved equal:
 - a. Type "FB1" floor box: Ace Backstage FULL STAGE POCKET, to include ISO102BBXW 6" deep backbox, Ace Backstage PE panel for Div. 26-supplied duplex power receptacle, and Full Pocket Lid Assembly (provide finish options to Owner and Architect with submittal package for direction). The Installer shall verify lid requirements with finished floor type, site conditions, and the Architect prior to product acquisition and use appropriate version for each location. (Qty: as shown)
 - b. Type "FB2" floor box: Ace Backstage FULL STAGE POCKET, to include ISO102BBXW 6" deep backbox, Ace Backstage PE panel for Div. 26-supplied duplex power receptacle, and Full Pocket Lid Assembly (provide finish options to Owner and Architect with submittal package for direction). The Installer shall verify lid requirements with finished floor type, site conditions, and the Architect prior to product acquisition and use appropriate version for each location. (Qty: as shown)
 - c. Type "FB3" floor box: Ace Backstage FULL STAGE POCKET, to include ISO102BBXW 6" deep backbox, Ace Backstage PE panel for Div. 26-supplied duplex power receptacle, and Full Pocket Lid Assembly (provide finish options to Owner and Architect with submittal package for direction). The Installer shall verify lid requirements with finished floor type, site conditions, and the Architect prior to product acquisition and use appropriate version for each location. (Qty: as shown)

2.04 EXTERIOR WALL BOXES

- A. Furnish and install NEMA-4 rated enclosure(s) for use with Audiovisual connectivity at the building exterior.
- B. Unit(s) shall provide single-door access and be provided with flush-mounting accessories for recessed mounting. Provide manufacturer's interior bracket(s) in configuration(s) to accommodate connector plate(s) provided by Div. 27 41 15.
- C. Furnish and install the following, or approved equal:
 1. Type "L" Exterior Wall Box: FSR, Inc. OWB-CP1-WHT assembly, to include enclosure, locking door (no window), and internal bracket to accept 3-gang connector plate. For each unit supplied, provide OWB-CP1-FMB-WHT Flush-Mount Bracket. (Qty: as shown)
 2. Type "WL2" Exterior Wall Box: FSR, Inc. OWB-CP1-WHT assembly, to include enclosure, locking door (no window), and internal bracket to accept 2-gang connector plate. For each unit supplied, provide OWB-CP1-FMB-WHT Flush-Mount Bracket. (Qty: as shown)

2.05 DIGITAL SIGNAL PROCESSING

- A. Processor shall be QSC or Symetrix, with a minimum of 8 Dante network audio inputs and 8 Dante network audio outputs.
- B. All network connections to be coordinated with the Owner's network representatives. The Owner's IT department to set-up static IP addresses in association with the Installer.
- C. Provide all data interconnection cabling as shown.
- D. System programmer shall be advanced manufacturer-certified for programming specified DSP product/system.

- E. Input/output connections shall be as required for the functionality shown on the drawings.
- F. A designer software application shall be provided that operates on a Windows computer, with network interface installed, running Windows operating system. Computer connection for configuration shall be via the device's rear panel Ethernet connector. All internal processing shall be digital (DSP). Available DSP components shall include (but not be limited to) various forms of: mixers, equalizers, filters, crossovers, dynamics/gain controls, routers, delays, remote controls, meters, generators, onboard logic, and diagnostics.
- G. The front panel shall include a LCD and momentary switch. The display shall indicate unit name, IP address, MAC address, Site File version, and fault messages and can be switched between system overview and meter displays.
- H. The system processor shall support custom user control interfaces on either proprietary touch screen controllers, network computers utilizing a control application, iOS devices, or any device with a standard web browser. Custom control interfaces shall be capable of having multiple user-selectable pages with different controls on each. All GUI's shall be submitted to the consultant for approval prior to programming and finalization.
- I. Provide and install most current version of manufacturer's configuration software at time of installation. All DSP hardware devices shall be updated to the most current firmware version at time of installation; all devices shall run the same firmware version.
- J. Furnish and install the following as indicated in the accompanying Audiovisual drawings, or approved equal:
 - 1. Digital Signal Processor: Symetrix Prism 12 x 12 Dante. (Qty: 1 ea.)
 - 2. DSP Control Server: Symetrix Control Server set up to serve iPad control mirroring "C7" device touch screen control interface (Qty: 1 ea.)
 - 3. Network Switch: Netgear M4250-26G4XF-PoE+ (GSM4230PX) with (24) 1G PoE+ ports, (2) 1G ports, and (4) singlemode fiber ports managed network switch, 480 W PoE power budget. (Qty: as shown)
 - 4. Wireless Access Point device AP: Netgear WAX620 PoE-powered dual-band 802.11ax Wi-Fi access point. This device is dedicated to the AV system data network and is not associated with any building network functionality. (Qty: as shown)
 - 5. Control Panels, device "C7": 7" touch screen controllers manufactured by digital signal processor manufacturer, located as shown in the drawings. (qty. as shown in the drawings)
 - 6. I-pad: configure iPad for (see Mixing Consoles section) with digital signal processor app, to mirror control at C7 touch screens.
- K. DSP Programming:
 - 1. Successful Contractor shall be responsible for programming the software configuration file for system based on intended functionality as follows:
 - a. The system shall be programmed so the default operating condition is auto-populated upon system power-up.
 - b. Terminate and program fire alarm interface at each system if/as required by the AHJ. If required, the system shall be programmed to mute all program audio upon receipt of contact closure from the addressable fire alarm module, provided by fire alarm vendor, at each system location.
 - 2. Contractor shall provide a review copy of each file to the Consultant for review no later than two weeks prior to scheduled commissioning trip.

2.06 POWER AMPLIFIERS

- A. Each power amplifier shall have an input connector which is either a screw-type barrier strip or XLR type. Output connections shall be barrier strip. Other types of connectors shall not be accepted.
- B. All power amplifiers shall have detented stepping input level controls. Install the units in the equipment racks, and connect as indicated in the Drawings.
- C. Provide security covers on all amplifiers if required to prevent misoperation.
- D. Furnish and install the following:
 - 1. PA-01: Powersoft Duecanali 4804 DSP+D, or approved equal Dante networked power amplifier. (Qty: 1 ea.)
 - 2. PA-02: Powersoft Mezzo 324 AD, or approved equal Dante networked power amplifier (Qty: 1 ea.)

2.07 LOUDSPEAKERS

- A. The drawings indicate the loudspeaker positions and aiming points for each loudspeaker.
- B. Loudspeakers shall be mounted to the structure, at the positions and angles indicated relative to the aiming points. Suspend each component with commercial rigging hardware, in such a way as to facilitate minor angle adjustments. Safety factor shall be at least 5. Furnish mounting and rigging details during submittal process. Secure any loose hardware to prevent vibration and rattling. Orient each speaker at the location and angles indicated in the drawings. Make minor adjustments as required to provide even sound distribution.
- C. Measure and record the impedance of each driver at the amplifier terminals. High frequency drivers shall be measured at 1000Hz; low frequency drivers shall be measured at 250Hz. Include the measurements in the final documentation.
- D. For loudspeakers incorporating 70.7v transformers/autoformers, tap as indicated in the drawings.
- E. Verify factory color option selection with Owner / Architect prior to product acquisition. Where field-painting is required, coordinate with the Architect regarding custom paint color selection and paint to match.
- F. Furnish and install the following:
 - 1. Main Loudspeakers: JBL CBT1000+1000E system, to include coupler plate. Provide and install MTC-CBT-FM2 flush mount bracket at each location. Manufacturer painted to match the wall color – obtain color swatch from Architect and furnish to manufacturer. (Qty: 2 of each system)

2.08 CEILING-RECESSED AND WALL-RECESSED LOUDSPEAKER ASSEMBLIES

- A. Furnish ceiling-recessed loudspeakers at the locations noted on the drawings.
- B. Ceiling-recessed speakers shall be installed in a recessed enclosure, whether it be a separate back can or part of an integrated loudspeaker assembly. Furnish braces designed to provide additional support to the weight of the speaker and prevent tile sag. Coordinate exact locations with the Owner. Connect the loudspeakers as indicated in the drawings. Furnish enclosures/back cans to Division 26 for installation if/where required.

- C. Verify factory loudspeaker color with Architect prior to product acquisition. Baffles shall be painted a color selected by the Arch./Owner. Coordinate with the Architect regarding color selection.
- D. Tap the transformers as indicated in the drawings. Measure and record the impedance at 1000Hz of each home run at the amplifier terminals. Include the measurements in the final documentation.
- E. Furnish and install the following, or approved equal:
 - 1. Recessed Ceiling Loudspeakers: Electrovoice EVID C4.2LP 70V recessed ceiling speaker assembly, tapped at 30 W. (Qty: as shown)
 - 2. Recessed Wall Loudspeakers: Electrovoice EVID FM4.2, Transformer version, tapped at 30 W (Qty: as shown)

2.09 VOLUME CONTROLS

- A. Furnish wall-mounted volume controls at locations indicated for use in controlling loudspeaker levels within each respective area.
- B. Size each device per total speaker load at each location / zone.
- C. Furnish and install the following, or approved equal:
 - 1. Type "V": Lowell Manufacturing **LVC-* 1-gang volume control (**=power rating, *=color). (Qty and power rating: as shown on the oneline diagram; color shall be verified with Architect and Owner)

2.10 PLAYBACK, RECORDING, AND INTERFACE DEVICES

- A. Furnish audio devices to facilitate the use of pre-recorded content or portable media. Connect as indicated on the drawings.
- B. Furnish and install the following, or approved equal:
 - 1. Type "BT" interface device: QSC Q-sys Attero Tech unD6IO-BT - Dante/AES67 wall plate - 4 x 2 multi I/O with Bluetooth® audio (Qty: 1 ea.)

2.11 WIRELESS MICROPHONE SYSTEMS

- A. Diversity UHF wireless microphone systems shall be used in this facility
- B. Operating frequency shall be as high as possible, and shall be selected so as to avoid interference.
- C. The Contractor shall perform a Wireless Frequency Scan in order to determine the proper frequency selection for each venue.
- D. Units are to be provided with rackmount kits, in the configurations shown in the accompanying drawings, and installed in equipment racks, whether fixed or portable racks, for use at each applicable venue.
- E. Furnish and install the following wireless system and accessories:
 - 1. Shure ULXD4Q Quad-channel digital wireless receiver. (Qty: 1 ea.)
 - 2. Shure ULXD2/SM58 Wireless handheld transmitter. (Qty: 1 ea.)
 - 3. Shure ULXD1 Wireless bodypack transmitter. (Qty: 3 ea.)
 - 4. Shure UA874US Active Directional Antenna, compatible with frequency range(s) of receivers supplied. (Qty: 2 ea.). Coordinate with Owner regarding mounting location.

5. Shure UA221 passive antenna combiner/splitter (Qty: 2 ea.)
6. Shure UABIAST in-line power adapter (Qty: 2 of each)
7. Save antennas that ship with the wireless receiver. Furnish mic stand mounts with antennas for portable outdoor use at outdoor wall box WL2. (Qty: 2 ea.)
8. Countryman B6* (* = B, T, C, LT) standard sensitivity omnidirectional lavalier microphone with TA4F connector. Verify with the Owner's representative for factory color selection – Black, Tan, Cocoa, or Light Tan. (Qty: 3 ea.)
9. Shure SB900B rechargeable battery. (Qty: 4 ea.)
10. Shure SBC200-US dual charging station, to include power supply. (Qty: 2 ea.)

2.12 MICROPHONES, STANDS, CABLES, AND DIRECT BOXES

- A. Furnish microphones, stands, and cables for use throughout the facility.
- B. Each microphone shall be equipped with its own cable, with Neutrik connectors installed on each end.
- C. Furnish and install the following:
 1. Ambo Microphone: Earthworks FM5R-C FlexMic Gen2 16-inch gooseneck microphone. Provide PMM1 Microphone Mount and install at Ambo; coordinate with Owner/Arch. as required. (Qty: 1 ea.)
 2. Vocal Microphones: Shure SM58-LC Cardioid Dynamic Vocal Microphone. (Qty: 4 ea.)
 3. Atlas Sound MS20E heavy duty microphone stand, black. (Qty: 4 ea.)
 4. Atlas Sound PB21XEB adjustable boom with counterweight, black. (Qty: 4 ea.)
 5. Type "SM" Suspended choir microphones: Earthworks C30 in white. Verify color with Architect and Owner prior to purchase. Work with owner to adjust microphone locations using monofilament line or alternate ceiling attachment points after choir furnishing locations are known. (Qty: 2 ea)
 6. Radial Engineering JDI passive direct box with Jensen transformer. (Qty: 2 ea.)

2.13 MIXING CONSOLES

- A. Furnish a mixing console for use in processing and routing microphone and line level sources.
- B. Furnish and install the following, or approved equal:
 1. Digital Mixing Console: Allen & Heath Qu-SB faderless mixer to be controlled by iPad. (Qty: 1 ea.)
 2. Wifi Tablet: Apple iPad Air 128GB (verify color with Owner). (Qty: 1 ea.)

2.14 PORTABLE LOUDSPEAKERS

- A. Furnish portable loudspeakers and accessories for flexible use as stage monitors or outdoor event loudspeakers.
- B. Furnish the following, or approved equal, portable active loudspeakers:
 1. QSC K10.2 2-way 10" active loudspeaker. For each unit supplied, provide QSC K10-TOTE, Atlas Sound SS500E Tripod Speaker Stand, Whirlwind MKQ25NP 25-foot balanced XLR audio cable (black), and 25-foot 14/3 power extension cord. (Qty: 2 ea.)

2.15 ASSISTIVE LISTENING SYSTEMS

- A. Furnish and install FM wireless assistive listening systems for use by the hearing-impaired. The assistive listening system (ALS) shall be capable of broadcasting on 57 channels and be frequency agile.
- B. The receiver shall have a programmable multi-function Listen button that can be tuned for the venues desired channels and electronically lock out any unused channels. The receiver shall have a signal-to-noise ratio of 70 dB or greater and shall have an audio frequency response of 50 Hz - 15 kHz (± 3 dB). The device shall employ a unique DSP SQTM noise reduction technology. The unit shall have a programmable squelch circuit. The unit shall incorporate a multi-functional display that indicates battery status, inventory number and channel. The device shall have the option of being lanyard or belt clip worn and the lanyard shall have the option of an integrated neck loop. The device shall have a USB connector used for inventory control, set up, charging and firmware upgrades. The device shall incorporate automatic battery charging circuitry and use a non-proprietary lithium ion battery. The device shall have additional charging contacts to allow multiply charging options.
- C. Supplemental transmission is provided via an assistive listening WiFi server distributed through the building WiFi wireless network. Personal reception is accomplished with a user-installed smartphone app, facilitating wireless connectivity to Bluetooth-enabled hearing aids.
- D. Furnish and install the following installed systems, or approved equal:
 - 1. Listen Technologies LS-55-216 iDSP Prime Level 3 Stationary RF System (216 MHz), to include (1) transmitter with rackmount kit, (4) rechargeable personal receivers, (4) intelligent Earphone/Neckloop lanyards, (4) universal ear speakers, 12-unit charging tray, ALS notification signage kit, and accessories. (Qty: 1 complete system)
 - 2. Listen Technologies LA-124 90° Helical Antenna (216 MHz). Remote mount at "ALS" location. (Qty: 1 ea.)
 - 3. Listen Technologies LW-100P-02 2-channel WiFi server. Coordinate with the Owner's IT staff for connection to building wireless network. (Qty: 1 ea.)

2.16 VIDEO STREAMING AND RECORDING

- A. Furnish pan-tilt-zoom observation cameras for use at each assembly space.
- B. System and devices shall incorporate NDI / NDI-HX streaming technology.
- C. Each camera shall provide ultra-high definition 1/1.8" CMOS sensor to deliver native 2160p video. Integrated lens shall provide 30x optical zoom. Units shall be PoE+ powered (IEEE 802.3at).
- D. Production system shall support 8 x IP video inputs via NDI® at any combination of standard frame rates, formats, and resolutions.
- E. Furnish and install the following in the Nave and Sacristy/Storage Room, or approved equal:
 - 1. Type "CM" cameras: PTZ Optics Move SE camera with 30x zoom, to include manufacturer's wall-mounting or ceiling-mounting bracket, as appropriate. (Qty: 1 ea.)
 - 2. Production computer and software: Windows personal computer with Windows 11 Pro operating system, 32 GB RAM, 8 or more processing cores at 2.4 GHz each or more average processing speed, at least one USB-C port, graphics card supporting dual displayport or HDMI monitors, a gigabit ethernet port, and a 2 TB solid state hard drive manufactured by Dell Computer, loaded with Wirecast broadcasting software purchased and registered in the Owner's name (Qty: 1 ea.)
 - 3. Desktop Camera Controller: PTZ Optics PT-JOY-G4 IP joystick camera controller. (Qty: 1 ea.)

4. USB Audio Interface: Focusrite Scarlett 2i2 two in, two out, digital USB-C audio interface (qty. 1 ea)
5. Keyboard and mouse: hardwired or wireless standard computer keyboard and mouse combo (qty: 1 ea)
6. Video monitors: Samsung Odyssey G series 27" display or equal. (Qty: 2 ea.)
7. Headphones: Audio-Technica ATH-M70x closed-back 45mm reference headphones. (Qty: 1 ea.)

PART 3 EXECUTION

2.17 INSTALLATION

- A. Furnish components, racks, wire, cabinetry, connectors, materials, parts, equipment and labor necessary for the complete installation of the systems, in full accordance with the recommendations of the equipment manufacturers and the requirements of the Drawings and Specifications.
- B. Installation shall follow standard broadcast wiring and installation practice, and shall meet or exceed industry standards for such work, with particular attention given to any installation instructions in Part 2 of these Specifications.
- C. Equipment shall be held firmly in place with proper types of mounting hardware. All equipment affixed to the building structure must be self-supporting with a safety factor of at least five. All equipment shall be installed so as to provide reasonable safety to the operator and occupants. Supply adequate ventilation for all enclosed equipment items which produce heat.
- D. Furnish the system to facilitate expansion and servicing using modular, solid-state components. All equipment shall be designed and rated for continuous operation and shall be UL listed, or manufactured to UL standards.
- E. Observe proper circuit polarity and loudspeaker wiring polarity. No cables shall be wired with a polarity reversal between connectors with respect to either end. Special care shall be taken when wiring microphone cables, to ensure that constant polarity is maintained. Balanced audio connectors shall be wired as follows.

<u>Wire</u>	<u>Connector</u>	<u>Signal</u>
Black	Pin #3 or Ring	Negative
Red or White	Pin#2 or Tip	Positive
Bare	Pin#1 or Shield	Ground

- F. Provide all audio circuits balanced and floating, except as noted in the Specifications or directed by the Consultant at the time of final equalization and testing. Shields of audio cables shall be grounded at one end only, at the outputs of the various equipment items in the system.
- G. Route cables and wiring within equipment racks and cabinetry according to function, separating wires of different signal levels (microphone level, line level, amplifier output, 120VAC, control, etc.) by as much physical distance as possible. Neatly arrange and bundle all cables loosely with plastic cable ties. Cables and wires shall be continuous lengths without splices.
- H. All system wire, except spare wire, after being cut and stripped, shall have the wire strands twisted back to their original lay and be terminated by approved soldered or mechanical means. No un-terminated wire ends will be accepted. Heat-shrink type tubing shall be used to insulate and dress the ends of all wire and cables. Include a separate tube for the ground or drain wire.

- I. All cables in conduits shall be insulated from each other and from the conduit the entire length and shall not be spliced. All cables and wires are to be continuous lengths without splices.
- J. All solder joints and terminations shall be made with rosin-core solder.
- K. Temperature regulated soldering irons rated at least 60 watts shall be used for all soldering work. No soldering guns or temperature unregulated irons shall be used on the job site.
- L. Mechanical connections shall be made using approved connectors of the correct size and type for the connection. Wire nuts will not be accepted.
- M. Each mechanical connector shall be attached using the proper size controlled-duty-cycle ratcheting crimp tool which has been approved by the manufacturer of the connectors. Conventional non-ratcheting type crimping tools are unacceptable, and shall not be used on the job site.
- N. Label all wires in racks and console as to destination and purpose with permanent labels. Clearly and permanently label all controls, connections, and equipment at the front and back of the rack with permanent Lamacoid labels. Wall plates and custom panels shall be engraved and filled with contrasting paint, unless otherwise noted. All labeling shall be completed prior to final system inspection.

2.18 SOUND SYSTEM FINAL TESTING AND EQUALIZATION

- A. Installer shall perform thorough preliminary testing of the Audio-Visual Systems prior to the final inspection by the Consultant. All systems and subsystems shall be tested to ensure that they are in proper working order and meet the performance specifications outlined in Part 3.03 below. Build the program for the digital signal processor and submit it to the consultant for review prior to commissioning. Install the processing program on the digital signal processor and test it for functionality.
- B. The completed Audio-Visual Systems shall be physically inspected by the Consultant to assure that all equipment is installed in a neat and professional manner, and in accordance with these Specifications. The Audio-Visual Systems shall be inspected and equalized by the Consultant with assistance from the Installer. Provide a minimum of two weeks' notice to the Consultant for final inspection and equalization.
- C. The testing and equalization work shall be performed after the installation work has been completed, but prior to any use of the system. During the testing and equalization work, the Installer shall have on the job site at least one (1) competent technician who is familiar with the project, and who will be prepared to stay as long as his services are needed. It is estimated that approximately eight hours will be required for this work.
- D. The process of equalizing and testing the system may necessitate moving and adjusting certain loudspeakers. Adjustments shall be performed without claim for additional payment.
- E. Coordinate as necessary to ensure a totally quiet room during the Sound System testing and balancing period.
- F. Prior to requesting systems testing, verify the following:
 - 1. All systems are in first-class working condition and free of short circuits, ground loops, parasitic oscillations, excessive system noise beyond published specifications of the equipment, hum, RF interference, or instability of any form.

2. All specified equipment, including loose and portable equipment is on the job site for proper accounting.
 3. All loudspeaker circuits have been tested, are configured at the proper crossover frequency, and are in perfect working order. Furnish impedance measurements of each circuit prior to final tests.
 4. All equipment controls are labeled, even if unused. If permanent labels cannot be furnished prior to system inspection, temporarily label every control as to its function with write-on tape. Supply labels or markers suitable for indicating knob settings after equalization is performed.
 5. Operation manuals for every equipment item furnished are on hand at the job site.
 6. Installer shall provide all signal processing software loaded on a portable PC and ready for use at time of testing.
- G. Should the performance testing show that the Installer has not properly completed the systems, the Installer shall make all necessary corrections or adjustments and a second demonstration shall be arranged at the Installer's expense.
- H. The final acceptance of the system by the Owner will be based upon the report of the Consultant following inspection, testing, and demonstration. A list of items in need of completion or correction shall be prepared by the Consultant, which must be corrected by the Installer before final acceptance will be granted.

2.19 SOUND SYSTEM PERFORMANCE

- A. After equalization and testing, the Sound System shall meet or exceed the following specifications:
1. System shall be free of short circuits, ground loops, parasitic oscillation, excessive system noise, hum, RF interference, and instability of any form.
 2. Maximum SPL with band-limited pink noise input to the system shall be 92 dB before audible distortion occurs.
 3. Spatial variation in SPL at 4 kHz octave band pink noise shall be within a tolerance of plus or minus 3dB SPL.
 4. Acoustic response of the system shall be plus or minus 1.5dB along a line which is +5dB per octave from 65 Hz to 125 Hz, flat from 125 Hz to 4 kHz, and which rolls off at 2dB per octave to 16 kHz, or as determined by the Consultant during commissioning.

2.20 OWNER TRAINING AND FAMILIARIZATION

- A. The Installer shall furnish the Owner's representatives with training necessary to properly operate the systems. Demonstrate in detail all functions of the systems. Provide a minimum of 8 hours for this basic training, broken up into two training sessions, at the discretion of the owner. These training session shall be videotaped by the installer and copies provided to the Owner with the as-built documentation.
- B. The Installer shall have a qualified representative, familiar with the Audio-Visual System, to assist in operation at (1) scheduled event, as selected by the Owner, in addition to the two training sessions.

END OF SECTION 274114

SECTION 28 46 00 – FIRE ALARM & DETECTION SYSTEM

PART 1-GENERAL

1.01 SCOPE OF WORK

- A. SPECIAL NOTE: All provisions and divisions of these specifications are a part of this section of these specifications. The Contractor shall consult these divisions and provisions in detail for instructions and include all items pertaining to this work. The Contractor shall consult all other divisions of these specifications, determine the extent of impact on the work required to complete the work required by this section of the specifications or portion thereof and related work shown on the drawings.
- B. SYSTEM DESCRIPTION OFFICE: The Contractor shall provide all equipment, materials, tools, labor, engineering, drawings, testing, and certifications necessary for a complete operational, code compliant fire alarm system elevator recall system for the entire building. The purpose of the contract documents is to convey to the Contractor the scope of work required, for which the Contractor is responsible to furnish, install, adjust and make ready for operation.
1. Complete finished out building.
 2. Shell Building:
 - a. Provide all devices in all finished-out common areas at this time.
 - b. **System shall be capable of expanding to provide Fire Alarm System expansion for entire building at tenant finish-out time.**
- C. SPECIAL NOTE:
Cad Drawings:
Architectural Background Files – Architectural Files are background files; MEP drawings are not background files. To insure the most current Architectural files are used for shop drawings backgrounds, they must be obtained from the architect and cannot be given from the engineer. Reference Architect for cost of Architectural Files.
- Contract Drawings** – These drawings cannot be used for shop drawings, as they are diagrammatic in nature only. Actual shop drawings prepared by sub-contractors must be used for coordination between all trades.
- MEP Drawings** – These drawings cannot be used for shop drawings, as they are diagrammatic in nature only. Actual shop drawings prepared by sub-contractors must be used for coordination between all trades. If MEP floorplan files are requested, they may be obtained for \$200.00 per file and a signed confidentiality release form. These files may be used in conjunction with this project only. There are no guarantees of compatibility or accuracy; all technical support will be billed hourly at current Engineer's Rates. See submittal and shop drawing section for additional information.
- D. All major elements of the work are described. The Contractor is expected, to anticipate and include in the cost of the work any incidentals that may be required, but are not specifically expressed, in order to provide a complete and fully functional fire alarm system for this structure.
- E. This is a performance specification. Specifications and drawings reflect the intent and scope of the project. The Contractor is expected to make allowances for necessary adjustment during the actual system installation, to examine physical conditions, coordinate the actual device locations as

necessary to accommodate the existing conditions, obstructions, manufacturer's installation specifications, applicable codes, and the work of others. No extra payments will be allowed for the Contractor on account of extra work made necessary by his failure to make such allowances. The cost associated with this task shall be included in the Contractor's base bid. Any case of error, omission, discrepancy or lack of clarity shall be promptly identified to the Owner for clarification prior to submission of the base proposal price. **CONSTRUCTION AND INSTALLATION DRAWINGS SHALL BE PREPARED BY A STATE OF TEXAS LICENSED ALARM DESIGNER, NICET 111 OR PE (REGISTERED PROFESSIONAL ENGINEER) IN THE STATE OF TEXAS. FIRE ALARM CONTRACTOR TO BE ACR CERTIFIED.**

1. The Installing Contractor shall be licensed by the Texas Commission on Fire Protection to sell, install and service Elevator Recall Systems as required by Article 5.43-2 of the Texas Insurance Code. Reference Elevator Recall Specification.
- F. Drawings reflect general location of devices and may not include all devices.
- G. **Contractor to provide all devices required by code and local authorities and should appear on Fire Alarm Shop drawings.** The Contractor shall provide all devices and equipment as required by these specifications. Deviations from the specified items shall be at the risk of the contractor until the date of final acceptance by the architect, engineer, and owner's representative. All costs for removal, relocation, or replacement of a substituted item shall be at the risk of the contractor.
- H. Voice Evacuation: The Fire Alarm Contractor shall provide ADS (Acoustically Distinguishable Space) drawings with fire alarm shop drawings to show proper performance of intelligibility throughout the campus. They are to be approved, along with the shop drawings, by the Fire Marshal.
- I. **Fire Alarm Contractor to obtain system approval from Local Fire Marshall. System Planner's Name and License Number are to appear on shop drawings.**
- J. **Duct detectors on air handlers must be connected to the alarm panel, and the location of the detector must be clearly indicated at the fire alarm panel.**
- K. **Electrical Contractor is to coordinate location of back boxes for exterior devices prior to exterior walls being erected, to insure flush mount devices are installed where specified.**
- L. **For standard rough-in locations of A/V or Visual Devices in most rooms reference Detail "Typical Device Location Next to Doors".**
- M. **Reference Mechanical Unit Schedule for additional duct detector requirements and quantity of gas fired Mechanical Equipment which requires Carbon Monoxide (CO) detection.**

1.02 PERFORMANCE GUIDELINES

- A. This Contractor shall provide labor, materials, equipment, and installation for a functional fire alarm and as outlined in these specifications and shown on the drawings. The Contractor shall be responsible for compliance with the entire project specifications as well as the following guidelines. The guidelines are not intended to be all-inclusive, to limit or define the Contractor's Scope of Work. The work includes the following:
 1. Installation of a complete operational point addressable fire alarm system.
 2. Core drilling and fire stopping.

3. Cutting, patching and fire caulking. (Keep UL details at site for fire caulk being used.)
4. Detailed shop drawings.
5. Coordinate the work with other trades for this project and coordinate with any other Owner projects in the building ongoing at the time of Fire Alarm Contractor's work.
6. Provide on-site project supervision by a person licensed by the State Fire Marshal while any installation is being performed.
7. Develop a construction schedule, conduct bimonthly job progress meetings, and issue bimonthly written job progress reports to the Owner and Engineer.
8. Provide record documents as required by code, AHJ and specifications.
9. Provide operating and maintenance instructions.
10. Conduct a test of the system upon completion of installation to assure the Contractor and the Owner that the system is operational. This test shall take place prior to the commissioning test.
11. Conduct the commissioning test. The Fire Alarm Contractor shall furnish personnel who are familiar with the installation at a time convenient to the Authority Having Jurisdiction, Owner and Engineer.
12. Provide training of Owner's personnel.
13. Provide design and as built drawings in ACAD 2000 or later DWG format.
14. Provide 1-year job site warranty of all materials and labor furnished under this section. The 1-year warranty shall begin upon Authority Having Jurisdiction, Owner and Engineer acceptance.
15. Provide final approved printed set of fire alarm drawing in main electric room. Put in 4" PVC labeled tube and secure to wall.

B. Devices required but not limited to the following areas:

1. Visual devices in all rooms except single offices, janitor's room and small mechanical rooms.
2. Pull stations at every door to exterior of building maximum 200 ft. between pull stations and on second floor as required by code.
3. Audio/Visual devices in all common area toilet rooms and visual device in single fixture restroom.
4. Install Audio/Visuals in corridors spaced to be clearly audible above ambient noise (Maximum 100' o.c. and not more than 15' from the end of a corridor) and as required by local Fire Marshal or authority having jurisdiction.
5. Connect tamper/flow switches for the sprinkler system. Switches provided by Sprinkler Contractor. Coordinate with Sprinkler Contractor for compatibility.

6. Provide twenty percent (20%) excess capacity in the fire alarm panel and on each circuit to allow for future expansion by the owner.
7. Provide rough-in junction boxes for all devices and conduit to above ceiling or accessible area.
8. Smoke detectors in all storerooms, Technology/Data rooms, and any room housing power supplies.
9. Heat detector in all electric and Technology/Data rooms.
10. Provide magnet hold opens and door releases for all fire doors and coiling doors. Reference architectural door schedule and hardware specification for quantity, location and type. Make all required connections.
11. Install smoke or heat detectors at each Elevator landing per code and authority having jurisdiction.
12. Install ceiling mounted heat and smoke detectors in Elevator Machine Room.
13. Provide connection to the elevator machine equipment for shutdown, recall and notification of elevators in accordance with ANSI A17.1. The Elevator Recall System Contractor shall provide all equipment, materials, and labor required for the shutdown of elevators if hoistways and or elevator machine room has or is to receive a fire sprinkler head. Heat detectors shall also be added as required.
14. Provide all relays and wiring to elevator controller for Primary Recall, Alternate Recall and Fireman Service.
15. Install exterior device as required by code and plans.
16. Provide fire alarm annunciator panel (FAAP) in reception and fire sprinkler riser rooms.
17. Install duct smoke detectors in supply and return air of all units 2000 CFM and greater and units serving rated egress ways. Detectors provided by Fire Alarm Contractor, installed by Mechanical Contractor, final connection by Fire Alarm Contractor. Coordinate with Mechanical Contractor. **Refer to Mechanical Equipment Schedule for additional information.** Fire Alarm Contractor to provide, set and connect to relay with shut down contacts inside air mover device control panel, if space prohibits installation of relay inside air mover device control panel, then install relay in an enclosure (Nema 1 or Nema 3R as required) mounted on air mover device. Electrical Contractor shall provide and install control wiring from relay to air mover device controls cabinet. Coil wire in controls cabinet for Mechanical Contractor to make final connection to air mover unit controls.

At Fire Alarm Contractor's option, FULL AREA DETECTION may be used in lieu of duct detectors.

Provide smoke detectors in any existing units as required, field verify locations.
18. Fire Alarm Contractor to make connections in FACP.
19. Provide devices in all common areas at this time.
20. Provide visual device directly outside fire sprinkler room.

- C. Coordinate final location of fire alarm panel with Owner and Engineer.
- D. Fire Alarm Contractor responsible for all rough-in and providing power for fire alarm panel and power supplies.

1.03 APPLICABLE STANDARDS

- A. The following standards and guides (current adopted edition) are hereby made a part of this work by reference there to.
- B. National Fire Protection Association (NFPA):
 - 1. NFPA 13 - Installation of Sprinkler Systems,
 - 2. NFPA 20 - Installation of Centrifugal Fire Pumps,
 - 3. NFPA 70 - National Electrical Code,
 - 4. NFPA 72 - National Fire Alarm Code,
 - 5. NFPA 90A - Standard for the Installation of Air-conditioning and Ventilating Systems
 - 6. NFPA 92A - Recommended Practice for Smoke Control Systems
 - 7. NFPA 92B - Guide for Smoke Management Systems in Malls, Atria, and Large Areas
 - 8. NFPA 101 - Life Safety Code
 - 9. NFPA 110 - Emergency and Standby Power Systems
 - 10. NFPA 1221 - Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems
- C. Underwriters Laboratories latest edition:
 - 1. UL Standard 346, Waterflow Indicators for Fire Protective Signaling Systems
 - 2. UL Standard 268, Smoke Detectors for Fire Protective Signaling Systems
 - 3. UL Standard 521, Heat Detectors for Fire Protective Signaling Systems
 - 4. UL Standard 827, Central Stations for Watchman, Fire Alarm and Supervisory Services
 - 5. UL Standard 268, Smoke Detectors for Fire Protective Signaling Systems
 - 6. UL Standard 864, Control Units for Fire Protective Signaling Systems
 - 7. UL Standard 1424, Cables for Power-Limited Fire Protective Signaling Systems
 - 8. UL Standard 1480, Speakers for Fire Protective Signaling Systems
 - 9. UL Standard 1481, Power Supplies for Fire Protective Signaling Systems
 - 10. UL Standard 1971, Signaling Devices for the Hearing Impaired

11. UL Standard 1711, Amplifiers for Fire Protective Signaling Systems
12. UL Standard 2524, Standard for In-building 2-Way Emergency Radio Communication Enhancement Systems
- D. American National Standards Institute (ANSI) A17, Safety Code for Elevators and Escalators, latest edition.
- E. Americans with Disabilities Act Accessibility Guidelines (ADAAG) latest edition.
- F. Texas Accessibility Standards (TAS), latest approved edition.
- G. International Fire Code (IFC) current edition.
- H. International Building Codes (IBC)
- I. IEC 60268-16:2011(E) Sound system equipment – Part 16: Objective rating of speech intelligibility by speech transmission index.
- J. ISO 7240-24:2010 Fire detection and fire alarm systems – Part 24: Sound system loudspeakers.
- K. ANSI 117.1 American National Standard for Accessible and Useable Buildings and Facilities.
- L. FCC Title 47 Part 90, Safety and Special Radio Services - Private Land Mobile Radio Services
- M. FCC Title 47 Part 15b, Safety and Special Radio Services – Radio Frequency Devices
- N. All requirements of the local Authority Having Jurisdiction (AHJ).

1.04 DEFINITIONS AND ABBREVIATIONS

- A. Approved: Unless otherwise stated, materials, equipment or submittals approved by the Owner and Engineer.
- B. Authority Having Jurisdiction: Local Fire Department having jurisdiction
Texas Department of Insurance State Fire Marshal's Office
- C. Concealed: Where used in connection with installation of piping or conduit and accessories, shall mean, "hidden from sight" as in shafts, furred spaces, in soffits, in walls or above suspended ceilings.
- D. Contractor: The company awarded the prime contract for this work and any of it's subcontractors, vendors, suppliers or fabricators.
- E. Exposed: Where used in connection with installation of conduit and accessories shall mean "visible" or "not concealed".
- F. Acoustically Distinguishable Space (ADS): An area distinguished, enclosed, or physically defined from other spaces due to acoustical, environmental, or use characteristics, such as reverberation time and ambient sound pressure level. A basic area of a building or a single room identified for individual measuring of intelligibility.

- G. Common Intelligibility
Scale (CIS): A system created to map all quantitative intelligibility measurement methods to the same scale so that all different results can be compared.
- H. Speech Transmission
Index (STI): A scale and quantitative methodology for measuring the intelligibility of a communication system using a test signal audible program of wide band modulating frequency tones, which encompass a combination of vowels and syllables simulating common speech. While the test signal is being played through the communication system, the test instrument computes the signal to noise ratio based on the impact of background noise, reverberation, and distortion. During the test runtime, a value is calculated, and the result displayed on the test instrument screen which will be between zero and one on the STI scale, representing the weighted average estimate of system intelligibility at that location.
- I. Voice Intelligibility or
Speech Intelligibility: The quality or condition of being intelligible, capable of being understood; comprehensible; clear, precise and audible. Voice intelligibility test results for an emergency communication system are considered acceptable if at least 90% of the measurement locations within each ADS have a measured STI of not less than 0.45 (CIS of not less than 0.65), and an average STI of not less than 0.50 (an average CIS of not less than 0.70).
- J. Delivered Audio Quality (DAQ): A measure of speech intelligibility of land mobile radios.

1.05 RELATED WORK

- A. Related work existing or specified in other sections:
 - 1. Electrical
- B. Existing equipment or equipment furnished and installed by others under another section of the specification to be wired, and connected to the fire alarm system by the fire alarm contractor as required:
 - 1. Fire Smoke dampers are furnished and installed by others. The Fire alarm contractor to provide an alarm relay (contacts rated minimum 10 amp) for control.
 - 2. AHU, RTU, HVLS Fan (equipment) shutdown control. Fire alarm Contractor to provide an accessible control relay for equipment control. Fire alarm contractor to provide necessary wire conductors from control relay to equipment connection point. Fire Alarm contractor to provide and install duct smoke detectors.
 - 3. Provide electrical power connections to all fire alarm panels.
 - 4. SPECIAL SYSTEM: Fire suppression system alarm micro-switch provided by others, to be wired and monitored by the fire alarm contractor.

1.06 PERFORMANCE REQUIREMENTS

- A. Install a UL listed point addressable fire alarm and supervisory alarm system. Acceptable manufacturers are listed in the Part II - Products section. The new system shall include but, is not limited to, the following as required:
 - 1. Provide devices to properly monitor and supervise the sprinkler system devices. This includes all waterflow devices, all valve supervisory devices, and all devices associated with the fire pump to be installed by the Sprinkler Contractor.

2. Where voice evacuation is required provide shut down of amplified sound system upon alarm.
3. Provide user controls *for* override of smoke control/fan shutdown functions to allow for maintenance and testing to minimize disruption of normal activities, i.e. walk test or service group functions.
4. All initiating devices shall have a unique digital address. Monitor devices for water-based fire extinguishing system valve position supervisory switches shall be allowed to have a maximum of five (5) supervisory switches per address provided the valves are located in the same physical area.
5. Where indicated on bid documents the audible portion of the public alarm shall be a voice evacuation system. Signals generated shall be the distinctive evacuation signal with a digitized textual message. It shall allow for voice paging to selected areas and an all-call control.
6. All system must be listed and approved as a smoke detector sensitivity test set and be capable of providing drift compensation.
7. All systems must be field programmable for all changes, alterations, modifications, additions, deletions and hardware and software upgrades.
8. All systems must be capable of generating comprehensive reports for sensitivity, verification counts and address registers.

B. Systems Circuit Wiring:

1. All fire alarm initiating device circuits (IDC) shall be NFPA 72, Style B, electrically supervised circuits from the point addressable interface modules to the devices.
2. All fire alarm point addressable circuits (SLC) shall be NFPA 72, Style 6, supervised signaling line circuits from the fire alarm panel to the point addressable sensors or point addressable interface modules.
3. All notification appliance circuits (NAC) shall be NFPA, Style Y, supervise notification appliance circuits from the fire alarm panel to the audible devices, and strobes.

1.07 SYSTEM OPERATION

- A. The point addressable fire alarm and supervisory system shall perform the following functions:
1. Continuous monitoring of the status of all-new alarm and supervisory signal initiating devices.
 2. Continuous monitoring of all new electrically supervised initiating, supervisory, and signaling circuits.
 3. Visible point annunciation of all fire alarm point trouble conditions at the control panel.
 4. Operation of elevator controls as indicated herein.
 5. Be silenced by a code or Firefighter key at the main or remote annunciators

- B. Upon change in status of any device on the system, the fire alarm control panel shall activate audible and visible status change indicators and display the system point number, point description and message associated with the point. Permanently record the change in status, time, date, point description, and message in the history buffer, and transmit the point ID information to the central monitoring station.
- C. Activation of any smoke detector, heat detector, manual pull station, supervisory device or other initiating device will cause the following functions to occur:
 - 1. Duct type smoke detector operation shall cause the following to occur:
 - a. Activate audible and visible status changes indicators and display the system point number, point description, and message associated with the point on the system's operator terminal.
 - b. Permanently record the change in status, time, date, point description, and message associated with the point in history buffer
 - c. Release electronically held open and or locked doors.
 - d. Activate smoke control system.
 - e. Activate the supervisory signal
 - f. Transmit supervisory condition using point ID to the Owners Central Station, point description, and message associated with the point on the system's operator terminal.
 - g. Permanently record the change in status, time, date, point description, and message associated with the point in history buffer
 - h. Activate the audio/visual alarm
 - 2. Supervisory device or trouble condition activation, including valve supervisory devices, shall: Activate audible and visible status with the point on the system's operator terminal.
 - a. Permanently record the change in status changes indicators and display the system point number, point description, and message associated, time, date, point description, and message associated with the point in history buffer
 - b. Transmit supervisory condition using point ID to the Owners Central Station
 - c. When the device in trouble is restored to normal, the control panel shall be automatically reset
- D. Activation of an auxiliary bypass switch for Elevator Recall System shall override the automatic functions either selectively or throughout the system and initiate a trouble condition at the control panel.

1.08 SUBMITTALS

- A. Submit the following equipment information:
 - 1. Manufacturer's data sheets with equipment to be used highlighted

2. Wiring diagrams of all equipment,
 3. Installation instructions for all equipment,
 4. Equipment dimensions,
 5. Equipment testing procedures,
 6. Equipment operation and maintenance manuals,
 7. Wire data sheets.
- B. Submit the following software information:
1. Complete sequence of operation with input/output matrix for all points
- C. Submit the following system calculations:
1. Standby battery capacity for fire alarm
 2. Standby battery capacity for voice alarm
 3. Standby battery capacity for all remote panels
 4. Voltage drop calculations for each type of circuit (identifying all mathematical formulas, variables, constants, and sources of the mathematical constants),
 5. Speaker zone/circuit loading (including amplifier loading),
 6. Strobe zone/circuit loading,
 7. Normal 120 VAC fire alarm panel(s) circuit loading,
 8. Normal 120 VAC voice alarm panel(s) circuit loading,
 9. Normal 120 VAC remote panel circuit loading.
- D. Provide the following shop drawing information (Shop drawings shall be prepared using AutoCAD. Shop drawings shall be drawn to scale: 1/8" = 1'0" for floor plans)
1. Complete point to point wiring diagrams showing all field terminations.
 2. Complete panel layout showing location of all modules, power supplies, batteries, and all field terminations.
 3. Complete system riser diagrams, indicating wire sizes and types,
 4. Interaction with all other building systems (i.e. elevator, AHU, FSD)
 5. Complete floor plans showing all devices with point numbers
 6. Main panel elevations
 7. ADS drawings.

8. Backgrounds for floor plans to be obtained from Architect not MEP Engineer. Reference Specification Section, "26 05 00 - General, 1.01, L".
- E. Submittal packages shall be signed by NICET III or signed and sealed by a PE registered in the State of Texas.
- F. Prior to start of construction, submit the information outlined in A, B, C, and D above as follows:
 1. Three complete system packages to the Owner for review by the Owner and Engineer.
 2. One copy of Authority Having Jurisdiction (AHJ) "Approved Plan"

1.09 PARTIAL SUBMITTALS ARE NOT ACCEPTABLE.

1.10 WARRANTY

- A. This Contractor shall provide a one-year written warranty against defects in material and workmanship furnished under this Contract. The costs of such warranty shall be part of the purchase price. The warranty shall commence when the Owner and Engineer accept the system and installation.
- B. The warranty shall include all necessary material, travel, labor and parts to replace defective components or materials at the job site. This Contractor shall commence repair of any "in warranty" defects within 8 hours of notification of such defects.
- C. The Contractor shall include, as part of the one-year warranty, a test and inspection of the new fire alarm devices within one month prior to the expiration of the one-year construction warranty. The Contractor shall provide a written report of any deficiencies and repair any of the deficiencies. The test and inspection report shall conform to the test and inspection form as described in NFPA 72 and as required by the AHJ.

1.11 UNIT PRICES

- A. The Contractor shall provide with his bid, unit price during construction for the items in the following list. The unit prices for the devices shall include the device, installation, 20 feet of conduit, wire, programming and any other required installation.
 1. Addressable rate of rise heat detector.
 2. Addressable photoelectric smoke detector.
 3. Beam smoke detector.
 4. Addressable duct smoke detector with relay.
 5. Addressable manual pull station.
 6. Point addressable monitor module.
 7. Point addressable control/relay module.
 8. 24 VDC Relay SP/DT, with 10 amp rated contacts
 9. Fire Alarm Speaker.

10. Strobe Wall Mount. 15/75, 30, 75, and 110 candela rating
11. Strobe Ceiling Mount. 15/75, 30, 75, and 110 candela rating
12. Speaker/Strobe Wall Mount. 15/75, 30, 75, and 110 candela rating
13. Speaker/Strobe Ceiling Mount. 15/75, 30, 75, and 110 candela rating
14. Horn/Strobe Wall Mount 15/75, 30, 75, and 110 candela rating
15. Horn/Strobe Ceiling Mount 15/75, 30, 75, and 110 candela rating
16. Remote 80-character LCD annunciator
17. Distributed power module
18. Intelligent power module
19. Stopper II manual pull station cover
20. Carbon Monoxide (CO) detector

1.12 QUALITY ASSURANCE

- A. The fire alarm system manufacturer or authorized distributor shall maintain a fully staffed branch office including application engineers, drafters and technical service personnel.
- B. All supplied equipment shall be new, currently manufactured, standard product of the manufacturer.
- C. All technical service personnel shall be regularly employed by the distributor of the fire alarm system.
- D. The installing Contractor shall hold a current license, issued by the State of Texas Commission on Fire Safety, to design, install, and service fire detection and alarm equipment.
- E. All electrical installation of the fire alarm system, including wire installation and terminations, shall be performed by personnel employed by the Fire Alarm Contractor.
- F. Any subcontractors used to install portions of the system shall be submitted and approved by the Owner and the Engineer prior to commencement of the installation.

1.13 SUBSTANTIAL COMPLETION

- A. Substantial completion shall be the date of AHJ inspection.

PART 2 - PRODUCTS

2.01 MAIN FIRE ALARM PARTS INFORMATION (Make sure this is 2.00, A-E stays on ONE page)

- A. Manufacturers
 1. Basebid shall be Silent Knight/Farenhyt (with Emergency Communication System)

B. Control Panel

1. **Silent Knight IFP-2100ECS or 6820EVS analog addressable control panel with Emergency Communication Systems.**
2. **Where voice evacuation is required, Contractor shall provide emergency communications at both the FACP and RVEP locations.**
3. **Provide LTE/IP Dual Path Fire Communicator – Honeywell ‘HWF2A-COM’ or equal as approved by local AHJ.**

C. **Fire Alarm System Devices**

1. Analog Photoelectric Smoke detector
2. Analog Heat Sensor (with Relay)
3. Addressable Relay Module
4. Duct Detector Enclosure
5. Addressable Input Module
6. Mini Input Module
7. Addressable Relay Module
8. Addressable Notification Module
9. Two Wire Smoke Detector Module
10. Detector Isolation Base
11. Detector Relay Base
12. Detector Sounder Base
13. Duct Detector Housing
14. Remote Test Switch For Duct Housing
15. Addressable Pull Station (with Stopper II cover or equal)
16. Beam type Smoke Detector (Fire Ray)
17. Document Box (SRD) confirm location.
18. Voice Evacuation Speaker/Speaker Strobes
19. Carbon Monoxide (CO) detector with sounder base (B2005) powered by UL listed power supplies.

D. Remote Transponder Panels

1. Power Module - #RPS-1000 or 5895XL

- E. ADA Emergency Call System
 - 1. ADA 100
- F. Approved Installers:
 - 1. JM Electronics
 - 2. Care Specialties
 - 3. Firetrol Protection Systems
 - 4. Skelton Timing Control
 - 5. Vanguard Fire & Security
 - 6. Other approved equals

2.02 MAIN FIRE ALARM PRODUCT DESCRIPTION

- A. Manufacturers
 - 1. Reference 2.00 above.
- B. Control Panel
 - 1. **The fire alarm control panel (FACP) shall be an intelligent addressable control panel with integrated in-building Emergency Voice Evacuation. The FACP must supervise low battery, loss of AC and loss of communication. The communication protocol on the SLC loop must be digital. Reference 2.00 above.**
 - 2. **The panel must have a built in 80-character LCD annunciator with the capability of having an additional eight supervised remote annunciators connected in the field.**
 - 3. **The FACP must have a built in UL approved digital communicator. The communicator must allow local and remote up/downloading of system operating options, event history, and detector sensitivity data.**
 - 4. **The FACP must automatically test the smoke detectors in compliance with NFPA standards to ensure that they are within listed sensitivity parameters and be listed with Underwriters Laboratories for this purpose.**
 - 5. Devices supported must include analog photoelectric, ionization smoke detectors, analog heat detectors, addressable input modules, relay output modules or addressable notification modules. There is to be no limit to the number of any particular device type up to the maximum of 127 that can be connected to the SLC. Devices must be same manufacturer as control panel. Reference 2.00 above.
- C. Normal operating power for the FACP shall be 120-volt AC supplied from dedicated circuits. All circuits shall be protected by circuit breakers of proper size.
- D. The fire alarm system shall be provided with an emergency standby power system consisting of backup batteries. Batteries shall be sealed lead-acid or gel cell of sufficient capacity to provide 24 hours standby operation plus 15 minutes in full alarm condition. All calculations shall allow a minimum of 20% safety factor for battery degradation.

- E. The FACP shall accommodate all specified initiating device, notification appliance and command points. Each initiating circuit shall allow a 25 percent expansion of connected detection devices and 20 percent expansion of connected monitor/control points. Each notification/signaling line circuit shall allow a 20 percent expansion of connected devices.
- F. The Fire Alarm Control Panel shall automatically interrogate each intelligent detector and shall analyze the detector responses over a period of time. If any intelligent detector in the system responds with a reading that is below or above normal limits, the controller shall differentiate between long term drift above the pre-alarm threshold (maintenance alert, indicative of the need for cleaning) and a fast rise above the pre-alarm threshold (indicative of a smoldering fire).
- G. The Fire Alarm Control Panel CPU shall receive analog information from all intelligent detectors to be processed to determine whether normal, alarm, pre-alarm, or trouble conditions exist for each detector. The software shall automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information shall also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.
- H. Each addressable device on an SLC loop shall systematically report for type identification. Loss of signal from any addressable device shall result in trouble condition indication at the control panel. If the inadvertent installation of another type sensor takes place, the system and the installed device shall operate however, a "WRONG DEVICE" trouble condition will display until the proper unit is installed or the programmed sensor type is changed.
- I. The system shall be capable of on-site programming to facilitate changes in operation, sensor sensitivity, or system expansion. The unit shall contain non-volatile EPROM memory; loss of primary and secondary power shall not result in loss of programming information.
- J. All system software and firmware shall be UL listed with the control panel and protected from unauthorized changes. The microprocessor shall contain and execute on site programmable logical statements for each control-by-event specific action to be taken when an alarm condition is detected at specific programmed points by the system. Control-by-event equations shall be held in non-volatile programmable memory and shall not be lost even if system primary and secondary power failure occurs. Any software or firmware changes made shall require a minimum of a 10% functional test of the system.
- K. The digital communicator shall have the basic capability to transmit the status of the following software zones:

Waterflow Fire Alarm (when applicable)
General Fire Alarm
Point Annunciating Alarm by Zone
Supervisory Alarm
Trouble Condition
Onboard Duct

- L. In addition, the digital alarm communicator shall transmit signals indicating: Panel Off-Normal, Signal Trouble, Low Battery, AC Power Failure, and software zone/point identification information for each addressable device that generates an alarm or trouble.

- M. The emergency voice/alarm system shall provide high-intelligibility voice signal amplification to drive 25 or 70 VRMS speakers as required. Frequency response of amplifier shall be 400-4000 Hz. Provide as indicated a panel mounted, low impedance, dynamic, push-to-talk microphone. The system shall broadcast a digitally recorded message up to four minutes in length on alarm. The message shall automatically repeat, play alarm tones, and repeat as long as the FACP is in alarm unless the message is overridden by keying message, unless otherwise instructed the message shall be; One round or code-3 temporal horn followed by "Attention, Attention, a fire emergency has been reported. Please leave the building using the nearest exit" or an equivalent standard statement.
- N. The amplifier, signal generator, power supply, output transformer, and speaker lines shall be continuously supervised. The FACP shall supervise the activation circuit. Provide circuit overload, overheat, over-voltage, polarity reverse, open/short, and automatic current limiting protection. Provide sufficient battery backup power capacity, from the FACP or a signal power expander, for operation without AC power for twenty-four hours of normal supervision and two hours of emergency operation at the end of the period. Fifteen minutes of evacuation alarm operation at maximum connected load shall be considered the equivalent of two hours of emergency operation; include a 20% safety factor in battery calculations to ensure adequate performance for the service life of batteries. The power supply/charger and batteries shall supply power limited operating and emergency power. The charger shall be capable of maintaining batteries in a fully charged state without damage and of bringing batteries from a fully discharge to a fully charged state within 48 hours of normal operation.
- O. The emergency voice/alarm panel shall be housed in a UL listed cabinet suitable for flush mounting. The door shall provide a key lock to access system microphone, key alike to the FACP. Operator instructions shall be clearly visible inside of cabinet. All internal components shall be enclosed (ie. dead front panel). All components shall be securely mounted, and all cable routed, and tie wrapped in a neat, professional manner. All equipment provided shall be UL listed for fire protective signaling.
- P. The system shall be a multi-purpose NFPA compliant, supervised, general purpose audio, and fire/emergency evacuation system. Approvals for the system shall include: UL 864, UL 1711, FCC Part 15, CE, CSFM, and MEA. The system shall be OSHA 1910.165 and ADA compliant.
- Q. The system shall include a voice evacuation system incorporating supervision during the broadcasting of background music and general paging.
- R. Standard on-board system features shall include digital voice messaging, a hand-held push-to-talk microphone with override priority, and a power supply/battery charger. The system shall be capable of interfacing with telephone systems for general paging announcements and will have night ringer capabilities. Form C contacts shall be provided for system alarm and trouble conditions. The system shall have an internal sounder to indicate trouble and shall be capable of being silenced using a trouble acknowledge switch.
- S. The system shall have three fire alarm notification appliance circuit inputs with a voltage range of 9 to 31 VDC. The system shall have eight priority ordered inputs, including: On Board Microphone, Auxiliary Input (Line Level), three Digital Messages, Telephone Paging Input, Night Ringer Input and Background Music Input. The system shall have preset audio levels for emergency messaging (prerecorded and live microphone). The system shall revert to a preset level regardless of the volume set for background music (BGM) or general paging. Background music inputs can be an AM/FM tuner, cassette, CD, or any other remote source. The system shall be supplied with customer unique messages. The system shall have a dual-tone tone generator with Code-3 Tone and Slow Whoop. When the system is on battery power, telephone page, night ring and background music shall be disengaged.

- T. The system shall have power-limited circuitry and class B wiring. Wiring terminal blocks will be removable and accept #18 - #12 AWG wire. Audio output voltage shall be selectable for 1V nominal line level, 25V, 70.7V, or 100V. The voice (live microphone or recorded message) frequency response shall be 275 Hz – 6.5 kHz +/- 2.4 dB, background music frequency response shall be 100 Hz – 15 kHz +/- 2.4 dB. The signal to noise ratio shall be better than 65 dB, dynamic range shall be better than 65 dB, total harmonic distortion shall be less than 1%.
- U. A microphone shall be located within the main FACP.
- V. For all microphones mounted remotely from the voice evacuation control unit, the circuit shall be supervised and activate a trouble signal if the circuit is disturbed.
- W. The BDA/ECRES System shall be a single portfolio to meet any application across the US with all Public Safety frequency bands supported, various models available for UHF, VHF, 700MHz, 800 MHz and multi-band. All-inclusive and fully integrated BDA with UL2524 In-building 2-Way Emergency Radio Communication Enhancement Systems listing, NFPA 72, CSFM listing, NFPA 1221 and IFC compliance. NEMA 4 Type (UL Type-4) Approved Equipment Enclosure and NEMA 3R Type (UL Type-3R) Approved Battery Enclosure. BDA Panel shall be provided with one dedicated 120-volt normal operating power and one additional 120-volt normal operating power circuit for the battery charger. All circuits shall be protected by circuit breakers of proper size.

2.03 REMOTE TRANSPONDER PANELS

- A. Distributed Power Module panels (RPS) shall be provided where required. The cabinets shall be surface mounted with a locking door or cover.
- B. The contractor shall supply power modules compatible with the fire alarm control panel. The power module must have 5 amps of output power. The Distributed Power Supply shall be capable of being connected via an RS-485 system bus (SBUS). The power module's RS-485 bus shall be electrically isolated providing ground loop isolation and transient protection.
- C. The RPS panels shall accommodate all specified initiating device and command points. Each initiating circuit shall allow a 20 percent expansion of connected detection devices and 20 percent expansion of connected monitor/control points.
- D. Normal system power shall be 120-volt AC power provided by dedicated circuits from the local emergency power panel. All circuits shall be protected by circuit breakers of proper size.
- E. The RPS panels shall be provided with an emergency standby power system consisting of backup batteries. Batteries shall be sealed lead-acid or gel cell of sufficient capacity to provide 24 hours of standby operation plus 15 minutes in full alarm condition. All calculations shall allow a minimum of 20% safety factor for battery degradation. The loss of AC or DC power at any RPS shall cause a distinct power failure signal.
- F. The RPS cabinets shall accept input/output (initiating, supervision, notification and/or command) modules for the specified points, zones and spares.

2.04 REMOTE POWER SUPPLIES/EXPANDERS

- A. Provide as required additional power supplies for notification appliance circuits or as a remote power supply. The signal power expander supply/charger and batteries shall supply power limited 24 VDC operating and emergency power. The charger shall be capable of maintaining batteries in a fully charged state without damage and of bringing batteries from a fully discharged to a fully charged state within 48 hours of normal operation. Provide sufficient battery capacity for operation without AC power for twenty-four hours of normal supervision and five minutes alarm operation at

the end of this period; include a 20% safety factor in battery calculations to ensure adequate performance for the service life of batteries.

- B. A minimum of four notification appliance circuit monitoring and control modules. The modules shall be designed to meet the required circuit Style Y configurations.
- C. Strobe synchronization modules
- D. Power supply with battery charger and standby batteries. Batteries shall be sized to meet the standby requirements of the FACP.
- E. Supervision and activation by the main fire alarm system.
- F. Each initiating circuit shall allow a 20 percent expansion

2.05 VOICE EVACUATION SPEAKER SIGNAL POWER EXPANDERS

- A. Provide as required additional power supplies for voice evacuation speaker notification appliance circuits, for strobe notification appliance circuits, or as a remote power supply.
- B. All interior strobe flashing shall be synchronized with external or built-in synchronization modules at one flash per second to meet UL 1971 requirements.
- C. Each evacuation signal power expander supply/charger and batteries shall supply power limited 24 VDC operating and emergency power. The charger shall be capable of maintaining batteries in a fully charged state without damage and of bringing batteries from a fully discharged to a fully charged state within 48 hours of normal operation. Provide sufficient battery capacity for operation without AC power for twenty-four hours of normal supervision and five minutes alarm operation at the end of this period; include a 20% safety factor in battery calculations to ensure adequate performance for the service life of batteries.
- D. Each signal power expander shall have an engraved plastic nameplate permanently attached indicating the devices device identification number as documented. Labels shall be 1/16" thick two-ply black/white acrylic sheet engraving stock with all sides beveled.
- E. Each signal power expander shall be connected to the FACP such that the trouble contacts on the power expander generate a trouble signal at the FACP.
- F. Conduit shall enter the equipment backbox only where conduit entry is specified by the manufacturer.
- G. Provide as required series auxiliary power supplies, each with one or two Farenhyt model VIP-50, 50 watt and/or VIP-125, 125-watt audio amplifiers as required, or equivalent.

2.06 EMERGENCY VOICE/ALARM SYSTEM (VOICE EVACUATION) STROBES, SPEAKERS, AND SPEAKER/STROBES

- A. Provide where indicated on plans an emergency voice/alarm communications service system. The system shall automatically provide for speakers to broadcast a pre-recorded voice message operation on alarm that shall include an audible signal temporal pattern (Code 3) meeting ANSI S3.41 standards.
- B. The system shall also provide for manual voice capability by keying the microphone, which shall override the pre-recorded message. The system shall be capable of emergency voice announcements at any time, whether the FACP is in alarm or not. Strobe operation shall be from

the FACP or SPX and synchronized. Strobe operation shall not be interrupted by microphone activation.

- C. Speakers shall be flush mount where possible and shall feature a high fidelity 400 to 4,000 Hz frequency response with 1/4 to 2-watt audio taps, 25 or 70 VRMS (field adjustable) providing approximately 77 to 90 dB @ 10 feet, varies by model. Horn Loudspeakers frequency response shall be 400 – 14,000 Hz.
- D. Audible signals shall be tapped to provide at least 15 dB above ambient sound levels measured at 5 feet above the floor in the occupied area. Audible/Visual Signals shall conform to ADA standards. Furnish and install where shown on the drawings or as required per NFPA and any local, state, federal codes, or laws. Notification appliance circuits serving employee work areas shall be initially installed with a minimum of 20% spare capacity for visible notification appliances to facilitate future accommodation of hearing-impaired employees. Strobe intensity (candela output) and audible decibel level shall be sized for the room size and area of coverage per ADA and NFPA/ANSI standards. Signal housings and grilles shall be white in color. Audible signals (strobes and strobe speakers) shall be imprinted 'FIRE' and the strobe lens shall be clear. All interior strobe flashing shall be synchronized.
- E. Provide synchronization control such that all strobe circuits are synchronous, for all notification appliance circuits - System Sensor SpectrAlert Advance model MDL3W synchronization modules or equivalent. Note that signal appliances that can synchronize on a single circuit, but not across all circuits are not acceptable.
 - 1. Ceiling Mount Speaker Only, **(USE WALL DEVICES UNLESS APPROVED IN SPECIFIC LOCATION BY OWNER)** select models to provide intelligibility as required per area. Shall be 6.5" minimum to 8" diameter cone speakers, UL 1480 listed fire-protective signaling devices with a line supervision capacitor. Speakers shall be designed for flush mounting with white grille and feature increased wattage, approximately 1/2 up to 5 watt audio transformer taps; AMK 6.5" 25watt rated loudspeaker coaxial enclosure with round white grille and tile bridge model SA615-EV-25v (25-v) or SA615-EV-70v (70-v), Quam 8" 20-watt rated loudspeakers with concentric mount hard fiber cone models: UL-7 round baffle (25-v), UL-5 round baffle (70-v), U22/25 2' x 2' tile replacement with integrated back box (25-v), and U22/70 2' x 2' tile replacement with integrated back box (70-v), and TOA 8" with round white grille 10-watt rated speaker, 5 watt transformer, 70.7 V and 25 V model PC-580RU with HY-BB580 Back Can and Q-HY-TB2 tile bridge, or equivalents.
 - 2. Ceiling Mount Speaker Strobes, small area **(USE WALL DEVICES UNLESS APPROVED IN SPECIFIC LOCATION BY OWNER)** – System Sensor SpectrAlert Advance model SPSCW low candela range/high fidelity, model SPSCWV low candela range/high decibel, or model SPSCWVH high candela range/high decibel. Low candela range 15/30/75/95/100 or 115, high candela range 135/150/177 or 185 candela, 1/4 up to 2-watt audio, flush mount with round white grille and trim plate – or equivalent. Semi-flush mounting requires support and a 4" square x 2.125" deep backbox. For drop ceiling installation, include a Bosch model SSB-4 or equivalent ceiling support bridge.
 - 3. Wall Mount Speaker Only, System Sensor SpectrAlert Advance model SPW high fidelity or model SPWV high decibel 1/4 up to 2-watt audio, flush mount with rectangular white grille and trim plate – or equivalent. Semi-flush mounting requires a 4" square x 2.125" deep backbox.
 - 4. Weatherproof exterior surface wall mount speaker strobe with audio output 1/4 up to 2 watts and visual output shall be set at 75 candela per UL 1638 and, with square white grille. Shall be System Sensor SpectrAlert Advance model SPSWK complete with wall mount plastic weatherproof back box featuring 3/4-inch top and bottom conduit entries and

3/4-inch knockouts at the back and a screw-in NPT plug with an O-ring gasket for a watertight seal or equivalent.

5. Exterior WATERFLOW ALARM, provide a weatherproof exterior surface wall mount speaker strobe with audio output 1/4 up to 2 watts and visual output shall be set at 75 candela per UL 1638 and, with square white grille. Shall be System Sensor SpectrAlert Advance model SPSWK complete with wall mount plastic weatherproof back box featuring 3/4-inch top and bottom conduit entries and 3/4-inch knock-outs at the back and a screw-in NPT plug with an O-ring gasket for a watertight seal or equivalent. . Also provide a weatherproof sign approximately 12" wide x 6" high, white with red letters reading, "WATERFLOW FIRE ALARM SIGNAL". Configure fire alarm system to activate this strobe signal on waterflow alarm only. Center signal and sign directly over Fire Department Connection (Siamese Port).

2.07 MAIN FIRE ALARM SYSTEM EQUIPMENT

A. Alarm Initiating Devices: All alarm initiating devices must be compatible with and UL listed with the fire alarm control panel

1. Point addressable heat detectors listed under UL Standard 521 shall be provided where indicated and where elevator machine rooms and elevator hoistways are sprinkled.
2. Analog addressable photoelectric smoke detectors shall be provided where indicated.
 - a. Analog addressable photoelectric smoke detectors shall be provided with integral LEDs to indicate detectors in alarm. The detectors shall operate from the two-wire signaling line circuit and be listed under UL Standard 268. Line transient and RFI protection shall be built into the detector.
 - b. Duct-mounted analog addressable smoke detectors shall be provided where indicated. Motor control wiring shall not be routed through the duct detector housing.
3. The beam smoke detector shall have an operating range of 30 feet by 320 feet and shall have a range of field selective sensitivity setting from 7% to 50% of higher total obscuration. The beam smoke detector shall provide continuous supervision and shall be provided with an automatic gain control that compensates for slow ambient visibility changes. The detector shall operate on 24 VDC from the nearest power source UL listed for that purpose. The detector shall be supervised for alarm and trouble conditions. The detector shall be installed in accordance with the manufacturer's instructions.
4. Addressable point monitoring interface modules shall be used to monitor the waterflow switches and fire suppression systems. The interface modules shall provide Style B electrical supervision of circuits to monitored devices.

B. Supervisory Devices:

1. Valve supervisory devices existing or new shall be furnished and installed by the Sprinkler Contractor and wired by this Contractor as indicated. The valve supervisory devices shall be installed to transmit a supervisory signal within the first two turns of the control valve handle.
2. Accessory relays shall be provided as needed to supervise equipment. All accessory relays shall be SPDT.

3. Addressable point monitor interface modules shall be used to monitor all supervisory points. The interface modules shall provide Style B electrical supervision of circuits to monitored devices limited to five supervisory switches per initiating device circuit in one room.
- C. Control Devices:
1. Provide control relays/contacts where required. The control relays/coils shall be 24-volt DC low voltage type each with number of contacts as required and housed in metal enclosure. The contacts shall be rated for 10 amps as required for continuous duty and for the control circuit voltage.
 2. Addressable point control devices shall be used to provide all required control functions.
 3. Coordinate all door hold open devices and fire doors with architectural hardware schedule. Provide all things required for code compliant system control.
- D. ADA Emergency Call System:
1. Where required, provide and install an ADA Emergency Call System complete and in perfect operating order including boxes, conduit, wiring, telephones, master station and area station (at each rescue assistance area).
 2. System:
 - a. Vandal resistant, 16-gauge, 304 stainless steel.
 - b. Comply with ADA.
 - c. Master station NEMA 1 or NEMA 4 (where required) enclosure with lockable door and plexiglass front.
 - d. Area Stations: Large domed stainless steel engraved 3" diameter button (Push for help) stations to be NEMA 1 or weather resistant where installed outside.
 3. All cables shall be as recommended by manufacturer. All area stations must be home run with individually jacketed cable. All cables for exterior installations must be suitable for wet locations and appropriately grounded.
 4. Install system per manufacturer's requirements.
 5. Confirm final locations of rescue assistance areas with Architect prior to rough-in.
- E. SURGE PROTECTION FOR FIRE ALARM CONTROL UNITS
1. In addition to the built-in panel surge protection, each incoming 120 VAC power circuit shall be provided with an electrical surge protection module. Provide one for each fire alarm control unit, which includes every fire alarm control panel, digital communicator, signal power expander and any other 120 VAC powered fire alarm control units. Each power circuit surge protector module shall be mounted in a standard metallic electric box that is grounded and installed adjacent to the FACP, not inside the FACP. Module shall be hardwired in the incoming power circuit and 20 amp rated with 50kA surge current rating. Unit shall include Form C dry contacts for remote notification of surge protection status and LED diagnostic indicating light. Unit shall provide EMI/RFI filtering. Ditek DTK-120SRD or approved equivalent.

F. FIRE ALARM CIRCUIT SURGE PROTECTION

1. Electrical surge protection shall be provided for all entrance connections and on each copper pair that connects one building to another (i.e. any other portion of a building complex not under one continuous roof) at both exit points to prevent damage to equipment.
2. Fire alarm system circuit surge protectors for SLC, PIV, and NAC circuits shall be mounted in a standard grounded metallic electric box or equipment backboard with a separate ground wire ran directly to the ground bus bar or equipment panel ground stud, do not daisy chain ground wires. Unit shall be mounted in the vicinity of the FACP but not inside the FACP. Each unit shall have a minimum 20kA rating and designed for an operating current of at least 5 amps for NAC and PIV circuits and 1 amp for SLC circuits. Each unit shall include a staged hybrid design utilizing at least two different types of surge protection technology. Shall be Ditek 2MHLP or approved equivalent.
3. SLC Circuits shall be protected with Isolation devices per zone (floor level or region) so that "No single pathway fault shall cause the loss of more than 50 addressable devices on a signaling line circuit."

G. FIRE ALARM COMMUNICATION CIRCUIT SURGE PROTECTION

1. Provide surge protection on all telephone communication circuits, Ethernet circuits, or external wireless antenna cables that wire directly to the FACP. Surge devices shall be UL listed for the application.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. System components shall be installed in accordance with the latest revisions of the appropriate NFPA code, National Electrical Code, the requirements contained herein, local and state regulations, the requirements of the fire department and other applicable authorities having jurisdiction (AHJ). The Fire Alarm Contractor shall furnish on-the-job supervision for the proper installation of devices in cooperation with, or as may be required by, other trades. This supervision shall include, but not be limited to, the following:
1. Provide specific on-site instructions to others on mounting and installation of each type of device by physically observing the mounting of one or more of each type of device, as required, to assure that the installer is properly instructed in the work.
 2. Provide other supervision as required by the trades to properly interface fire alarm installation work.
 3. Perform a complete test of all devices, certifying that all devices have been activated and that the devices and systems perform in accordance with the requirements of these specifications.
 4. Install, test, troubleshoot and correct all system software provided under these specifications. This includes, but is not limited to, actual keyboard entry, reprogramming required to meet these specifications and any other task associated with the system software.
 5. Provide all necessary submittals to the authority having jurisdiction.

- B. The Fire Alarm Contractor shall furnish material and labor to provide a properly functioning system as described herein and in project drawings. The system shall operate in accordance with all the requirements of these specifications. No devices or equipment shall be used for any purposes other than their intended ones. This shall include, but not be limited to, the following:
1. Conduit, raceway and wiring systems shall be as indicated herein.
 - a. All exposed wiring shall be installed in conduit or wire mold.
 - b. All conduit fittings shall be threaded with plastic inserts
 - c. All riser wiring and wiring between floors shall be installed in conduit.
 - d. Conduit to waterflow and valve supervisory switches shall be weatherproof
 - e. Wiring, cables, conduits and raceways shall be neatly run parallel and perpendicular to building lines.
 - f. All raceways shall be of metal construction. Plastic conduits shall not be acceptable.
 - g. All cable not run in raceway shall be parallel/perpendicular to building lines and secured to the building structure. Provide bridal rings, D rings, or J hooks. Wire shall be neatly bundled with nylon wire ties at a minimum of four feet spacing.
 - h. All conduit shall be independently supported from structure. Conduit may not be supported from equipment, piping, ductwork or other trade's supports.
 - i. Do not route conduit under ductwork or other equipment.
 2. Wire: All wire used on the fire signaling system shall be UL Listed as fire alarm protection signaling circuit cable per National Electrical Code, Articles 760.
 - a. Wire used for 120 VDC power circuits shall be minimum 12 AWG solid copper conductors, with THHN insulation and UL listed for fire alarm use.
 - b. All cables shall be plenum rated.
 - c. All wiring shall be appropriately sized based upon voltage drop calculations.
 - d. Any underground wire must be UL Listed for that purpose.
 - e. Do not run wiring under ductwork or other above ceiling equipment.
 - f. **All fire alarm wire shall match Owner special systems color code requirements, or red and/or red and white stripe only.**

SPK (Speaker)	=	Blue	16/2 Shielded
NAC (Audio/Visual, Door Hold Open)	=	Yellow	14/2
SLC (Smoke Detectors, Pull Stations, etc)	=	Red	16/2
SBUS (Communication Network)	=	Red & Blue	16/4 Shielded
HVAC SHUTDOWN	=	Orange	16/2

3. Junction Boxes:
 - a. System components shall be securely fastened to the building structure. Devices shall not be supported by wiring or by other installed electrical fixtures or conduits.
 - b. Each box shall be large enough to accommodate required splices and conduit in accordance with NFPA 70.
 - c. System components shall be securely fastened to the building structure. Devices shall not be supported by wiring or by other installed electrical fixtures or conduits.
 - d. Boxes at sprinkler risers shall be weatherproof.
 - e. Provide box covers for all new and reused junction boxes.
4. Patching of all walls, floors, and ceilings which are penetrated or damaged during construction and returning the surface to a condition matching existing adjacent surfaces.
 - a. All slab penetrations shall be completely sealed and made watertight.
 - b. Restore all fire rated walls to rated conditions. All fire rated wall penetrations shall be made in conduit and sealed with UL Listed "fire stop" caulking.
5. Mounting:
 - a. All devices shall be mounted in accordance with the manufacturer's instructions and shall utilize the manufacturer's suggested mounting box.
 - b. Surface-mounted devices shall be smooth sided, without knockouts.
 - c. Point addressable monitor modules and control modules shall be securely mounted in back boxes in an accessible location.
 - d. Field devices shall be labeled, and all labeling recorded on "as-built drawings" indicate location, address and type of remote devices.
 - e. Devices shall be flush or semi-flush mounted where possible.
 - f. System components shall be placed and installed to comply with the Americans with Disabilities Act.
 - g. All surface mounted devices shall be installed with appropriate back boxes. All work shall be neat and performed in a craftsman like manner.
 - h. All devices, which are mounted behind walls, shall be provided with access panels. Location of access panels shall be coordinated with the Owner.
 - i. Fire alarm system devices shall not be installed where they may interfere with the operation of other building systems, devices or features.
 - j. Devices and wiring installed in suspended ceilings shall be supported with appropriate bridge supports and ties.
6. **No cabling or conduit shall be run under ductwork, mechanical equipment or in front of access doors.**

- C. Pay for all permits, fees and charges required for this work.

3.02 TESTS FIELD QUALITY CONTROL

- A. The commissioning alarm test shall be coordinated with the Owner, Engineer and AHJ. A letter certifying that the installation is complete per drawings and specifications and fully operational per NFPA 72 shall be forwarded to the Owner and Engineer.
- B. The Owner, Fire Alarm Contractor, Fire Alarm System Supplier, the Engineer and an authorized representative from each supplier of equipment shall be in attendance at the commissioning test to make necessary adjustments. A commissioning test shall be conducted in accordance with NFPA 72 and Authority Having Jurisdiction requirements. The test shall include, but not be limited to:
 - 1. A test of the system for grounded, opened and shorted circuits.
 - 2. A test of each alarm and new supervisory signal-initiating device for functions specified.
 - 3. A test to verify that the alarm signals will operate under specified trouble conditions.
 - 4. A test to verify that the components and wiring will operate under specified trouble conditions.
 - 5. A test to verify that the system will perform all specified tasks.

C. VOICE INTELLIGIBILITY TESTING

- 1. Once the basic setup is complete, the gain structure is maximized, and the performance testing as outlined above is completed, this contractor shall conduct voice intelligibility testing as prescribed in the NFPA 72 and as follows:
 - a. The building shall be divided into Acoustically Distinguishable Spaces for testing by basic areas of the building and single rooms.
 - b. Final voice intelligibility testing shall be conducted in accordance with the test instrument manufactures written instructions and during normal hours of operation and under normal building occupancy conditions including all final room finishes, furnishings, and with a nominal number of occupants at their normal activity level, or as near as these conditions can be simulated. Simulation may include taking sample background noise measurements or “captured curves” for each designated ADS with stand in personnel for use in the testing process.
 - c. From each designated fixed-point test location in each ADS, the technician shall calibrate the test instrument, measure, and record the STI value while the test signal is played through the entire building emergency communication system.
 - d. Voice intelligibility test results for this emergency communication system will be acceptable if at least 90% of the measurement locations within each ADS has a measured STI of not less than 0.45 (CIS of not less than 0.65), and an average STI of not less than 0.50 (an average CIS of not less than 0.70). The contractor shall make any system adjustments or modifications needed for each ADS to pass the indelibility testing.
 - e. If an ADS does not meet the above requirements due to low readings, the testing procedures shall be verified, and adjustments made that may include increasing the volume of individual speakers, changing types or adding additional speakers,

or working with the Architect to provide acoustical treatments that will reduce inordinate background noise and/or reverberation.

- f. The final acceptance of the system by the Owner/Architect/Engineer will be based upon the proper performance of the completed system.

3.03 TRAINING

- A. Provide training for the operating personnel in proper system operation and required user maintenance procedures.
- B. The training program for the personnel shall include the following:
 - 1. Three customized Operating & Maintenance Manuals – Printed, comprehensive installation and maintenance manuals, assembled with covers and conforming to the specified equipment supplied, shall be furnished with the equipment. The manual shall include a material guide which shall include the replacement part numbers and description of all components used. The manual shall provide sufficient, concise information, including schematics, troubleshooting diagrams, layout drawings, printed circuit overlays, test and alignment procedures, interconnect diagram parts list, compatibility charts and theory of operation of all active devices to permit quick, efficient maintenance and repair of the equipment by a competent Fire Alarm Systems Technician.
 - 2. Two separate 1-hour training sessions for operating personnel. These sessions are to cover proper operating and response procedures. These instructions shall be sufficient to enable a previously untrained person to properly operate the system.

3.04 RECORD DOCUMENTS

- A. Contractor to obtain architectural backgrounds for producing shop drawings from the Architect. Electrical Engineer cannot provide architectural backgrounds.
- B. Provide two (2) full size prints, and a set of disks in AutoCAD 2004 format of drawings and wiring diagrams reflecting “as-built” conditions to the Owner.
- C. Provide system map at FACP and FAAP.
- D. Provide one (1) complete sets of “as-built” data sheets for all system-connected equipment to the Owner. (Hardcopy and PDF)
- E. Provide two (2) sets (hard copies) of the complete “as-built” software listing of all data files, event programs, print statements, etc. to the Owner.
- F. Provide a completed test form, which complies with NFPA 72, signed and dated by the fire alarm contractor.
- G. Provide completion certificate, signed by the authority having jurisdiction.
- H. Provide manufacturer’s recommended cleaning procedure for smoke detectors.
- I. Provide additional copy of Record Drawings in Document Box.
- J. Provide PDF set of As-Built Documents and data sheets on a thumb drive, labeled and left inside FACP.

- K. Provide all program files on USB drive to owner upon completion of system programming.

END OF SECTION

SECTION 31 11 00 – SITE CLEARING AND GRUBBING

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Extent of site clearing as shown on drawings.
- B. Protecting and preserving trees and vegetation designated to remain.
- C. Clearing of site, including, but not limited to the removal of unwanted trees, shrubs, and vegetation which is not designated to remain, and brush, branches, logs, rock, debris, rubbish and other objectionable material from the entire project area.
- D. Grubbing of site, including, but not limited to uprooting and removal of all stumps, roots, other organics, etc. to their full depth from the project area and disking to a depth of nine (9) inches.
- E. Removal and legal, satisfactory disposal of all material cleared and grubbed from the site.

1.2 CONDITIONS AT SITE

- A. Execute all work in an orderly and careful manner with due consideration for any and all surrounding areas, planting or structures which are to remain. Periodically, water as required to allay dust and dirt. Protect any adjacent property and improvements from damage and replace any portions damaged through this operation.
- B. Coordinate and comply with the following:
 - 1. Geotechnical Report.
 - 2. Local ordinances and requirements of authorities having jurisdiction
- C. Traffic: Conduct site clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks or other occupied or used facilities without permission from authorities having jurisdiction.
- D. Protection of Existing Improvements: Provide protections necessary to prevent damage to existing improvements indicated to remain in place.
 - 1. Protect improvements on adjoining properties and on Owner's property.
 - 2. Restore damaged improvements to their original condition, as acceptable to parties having jurisdiction.
- E. No trees shall be removed until the building, drives, pavement areas, walks and other proposed improvements have been staked-out. After these areas have been staked-out, the Owner, and Architect shall meet at the site with the Contractor to concur on which trees can be removed and which shall remain. The Contractor shall make minor modifications if directed to save existing trees which the Owner desires to have remain.
- F. Protection of Existing Trees and Vegetation: Protect existing trees and other vegetation not indicated or directed to be removed, against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within

drip line. Provide temporary guards as directed by the Architect at all trees near areas affected by the construction to protect trees and vegetation to be left standing.

1. Provide protection for roots over 1-1/2" diameter cut during construction operations. Cut faces shall be coated with emulsified asphalt, or other acceptable coating, formulated for use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out; cover with earth as soon as possible.

- G. The Contractor shall take proper precautions to protect adjacent or adjoining property from damage caused by clearing and grubbing activities. All damage shall be repaired or replaced at Contractor's expense.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 SITE CLEARING

- A. General: Prior to site clearing, the Contractor shall stake-out the limits of new construction. Remove trees, shrubs, grass and other vegetation, improvements, or obstructions within the limits of new construction. Remove such items elsewhere on site or premises as specifically indicated or directed. Removal includes digging out stumps and roots. The Contractor shall not remove any trees which are located outside the limits of new construction unless indicated on the drawings to be removed or unless directed to do so by the Architect or Owner. The Contractor shall take necessary precautions to protect all trees which are to remain, including providing barricades around trees located within ten feet (10') of any area of new construction.
- B. Topsoil: Topsoil is defined as friable clay loam surface soil found in a depth of not less than 4". Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones, and other objects over 2" in diameter, and without weeds, roots, and other objectionable material.
1. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material.
 2. Remove heavy growths of grass from areas before stripping.
 3. Stockpile acceptable topsoil in storage piles in areas shown, or where directed. Construct storage piles to freely drain surface water. Cover storage piles if required to prevent wind-blown dust. The Contractor shall, however, be responsible for providing any and all additional topsoil as required.
 4. Dispose of unsuitable or excess topsoil same as waste material, herein specified.
- C. Clearing and Grubbing: Clear entire site of shrubs and other vegetation, including all underbrush.
1. Completely remove stumps, roots, and other debris protruding through ground surface.
 2. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
 3. Place acceptable fill material in horizontal layers not exceeding 8" loose depth, and thoroughly compact to a density equal to adjacent original ground.
- D. Removal of Improvements: Remove all existing above-grade and below-grade improvements.

3.2 DISPOSAL OF MATERIAL

- A. All cleared and grubbed material becomes the property of the Contractor and shall legally and satisfactorily be removed and disposed of off-site. On-site burning will not be permitted.

3.3 FINAL SITE PREPARATION

- A. Remove all rubbish, debris, etc., resulting from Work of this Section from the site.
- B. After clearing, grubbing and discing the project site, rake and pick the entire site to remove all debris material.

END OF SECTION 31 11 00

SECTION 31 23 00 –EXCAVATION AND FILL

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

SCOPE

- A. The extent of this work is to be determined by site inspection in addition to information given on the drawings and in various sections of the specifications.

CONCEALED SUBSURFACE CONDITIONS

- A. Variations with conditions indicated in the contract documents shall be adjusted as described in the General Conditions.
- B. Civil Engineer's various site plans show existing underground utilities based upon information obtained from site surveys. Contractor shall contact electrical utility, gas utility, and other utility companies as well as Texas One Call before beginning any excavations or trenching work on the property. If Contractor cuts or otherwise damages utilities in the areas identified to him as having utilities in the areas of his work then he shall repair all damage at his expense. If the Contractor cuts or otherwise damages utilities in areas not identified as having utilities, the Owner shall pay for all such damage, although the Contractor shall be expected to inform the Owner immediately of all damage to any utilities as soon as possible. If it is an emergency situation the Contractor may be asked to make the repair in the interest of time and/or safety with the understanding that Owner will pay Contractor for such work.

EXCAVATION

- A. All excavation shall be unclassified. The term "unclassified excavation" shall be understood to mean any and all material encountered during excavation, whether or not shown on the drawings.
- B. Excavate for the building structure to the extent, depths and contours shown on the drawings. Refer to site plan which shows existing elevations and visit the site to determine final quantities of excavation and select fill or backfill required.
- C. Refer to Civil Engineer's site plan, which shows existing ground elevations and new finish floor elevation, as well as the foundation plan and building sections, and visit the site to determine final quantities of excavation and select fill required.
- D. Refer to Civil Engineer's site plan drawings and specifications for notes and details relative to excavation for concrete aprons and walks.
- E. Refer to Civil Engineer's site plan drawings and specifications for notes relative to Storm Water Pollution Prevention Plan which must be provided by the Contractor prior to beginning any work on the project.
- F. All material excavated shall be cleaned of debris such as roots, concrete, abandoned piping, conduit pieces, etc. Debris shall be removed from site and legally disposed of. Remaining dirt shall be stockpiled on the site where directed by Owner. This dirt may be used as backfill. Any remaining dirt shall be removed from site.

SUBGRADE PREP & SELECT FILL

- A. Refer to Civil Engineer's site plan drawings and specifications for notes and details relative to subgrade preparation and select fill properties and placement for concrete aprons and walks.

BACKFILL

- A. Materials from excavations may be used for backfill provided they are free of grass, roots, rocks, concrete or other trash. Any additional backfill required must be free of debris and provided from off site by the Contractor and must be approved by the Architect.
- B. Place backfill to an elevation 6 inches below finish grades to allow placement of topsoil over the backfill. Install and compact in maximum 8 inch lifts.
- C. Refer to Civil Engineer's and site plan drawings and specifications for notes and details relative to backfill for concrete aprons and walks.

TRENCH FILL

- A. Refer to Civil Engineer's site plan drawings and specifications and Mechanical Engineer's plans and specifications for notes and details relative to trench fill for site related structures and piping.

TOPSOIL

- A. Topsoil shall be placed at all locations as noted on Civil Engineer's site plan.
- B. Topsoil shall be a natural, fertile, friable soil, free of nut grass, and possessing characteristics of representative productive soils in the vicinity. It shall be obtained from naturally well drained areas and must be approved by the architect.
- C. Owner will provide seeding or turf grass under separate contract.

TESTING

- A. An independent materials testing laboratory selected and paid for by the Owner shall make a laboratory analysis of the fill material selected to verify its compliance with these specifications. A moisture-density curve shall also be prepared for the material. Costs of this material testing shall be borne by the Contractor.
- B. The testing laboratory shall make field density tests to insure that compaction of fill materials meets the requirements of these specifications. If compaction fails initial testing, all re-testing costs shall be borne by the Contractor.

CORRECTION & CLEANUP

- A. Re-compact and re-grade all areas that are softened, eroded and rutted before other construction is placed. Correct any settlement or erosion.
- B. The Contractor shall re-grade all disturbed bed and grass areas, replacing topsoil as required, but the Owner shall replant any shrubs, trees and grass.

END OF SECTION 31 23 00

SECTION 31 31 16 – TERMITE CONTROL

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

SUBMITTALS

- A. Provide manufacture's technical data and application instructions.
- B. Submit manufacture's certification that products are in compliance with current environmental protection statutes.

PRODUCTS

- A. Termiticide: Provide an EPA-Registered termiticide, complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.
- B. Acceptable Termiticides:
 - 1. BASF Corporation, Agricultural Products; Termidor.
 - 2. Bayer Environmental Science; Premise.
 - 3. FMC Agricultural Solutions; Talstar TI.
 - 4. Syngenta; Demon Max.
- C. Dilute with water to concentrate level recommended by manufacturer.
- D. Other solutions may be used as recommended by the Contractor if approved for intended application by local authorities having jurisdiction. Use only soil treatment solutions that are not harmful to plants.

EXECUTION

- A. Examine the following:
 - 1. Verify that soil surfaces are sufficiently dry to absorb toxicant, and ready to receive treatment.
 - 2. Verify that the area is well ventilated.
 - 3. Verify that anticipated weather conditions comply with label recommendations prior to application.
 - 4. Commencement of operations indicates acceptance of conditions.
- B. Remove all wood and cellulose-containing material from around foundation beams or slabs. Eliminate termite access to moisture.
- C. Solution Application:
 - 1. Apply soil treatment solution according to current EPA regulations.
 - 2. Add chemically inert coloring agent to solution to indicate which areas have received treatment.
 - 3. Apply solution as overall treatment under interior slab (both suspended structural floors and slabs on grade) and attached slab or walks areas.
 - 4. Apply to inside of foundation walls and areaways and around plumbing penetrations.

5. Apply solution along outside edge of building, 3 inches above grade prior to backfilling around foundation.
6. Allow minimum 12 hours for drying after application, before beginning vapor barrier, reinforcing placement and other construction activities.
7. Post signs in areas of application with warning that soil treatment solution has been applied.
8. Reapply soil treatment solution to areas disturbed by subsequent excavation and other construction activities following application.
9. Inspect and reapply treatment solution if necessary after heavy rainfalls subsequent to initial application.

WARRANTY

- A. Upon completion of initial application provide to the Owner the option of purchasing an annual inspection and treatment contract as well as a warranty against termite damage.
- B. Owner shall reserve the right to purchase or reject the annual inspection and treatment contract as well as the damage warranty at his sole discretion.

END OF SECTION 31 31 16

SECTION 32 13 13 – CONCRETE PAVING

The Conditions of the Contract and applicable requirements of Division 01 govern this section.

SCOPE

- A. Refer to drawings for extent of work under this section.
- B. These specifications shall also apply to work, which becomes necessary to repair existing site work concrete, which may become damaged during construction.
- C. These specifications shall also apply to site work concrete which is required to replace concrete cut out to allow placement of new plumbing, electrical or other utility lines.

FORMWORK

- A. Forms shall be steel or wood extending the full depth of the concrete above grade and sufficiently below grade to prevent caving of earth formed beams or slab edges.
- B. Forms shall be jointed neatly and tightly, staked securely to line and grade and braced firmly throughout. Forms shall be removed in a manner to preclude damaging the concrete and exposed surfaces.

MATERIALS

- A. Refer to notes on the site plan:
- B. Expansion joint material shall be construction grade redwood extending the full depth of the joint. Provide with 3/4-inch deep tacked on strip that can be removed to provide recess for joint sealant. Unless noted differently on the site plans.
- C. Expansion joint sealant shall be Sonneborn Sonolastic SL-1 for horizontal joints and NP-1 for vertical portions of joint such as curb faces. Provide tape or backer rod bond breakers, use primers when required, and install in strict accordance with the manufacturer's written instructions. Unless noted differently on the site plans.

FINISHES

- A. Sidewalks, stoops and equipment pads shall receive a light broom finish. All exposed corners and joint edges to be tooled or chamfered.
- B. Ramp surfaces shall receive non-slip tactile finish to be in compliance with TAS requirements.

END OF SECTION 32 13 13