

SPECIFICATIONS

Edinburg Economic Development Corporation

Edinburg Transit Terminal Interior Build-Out

Edinburg, TX

More Attentive Service

Milnet Architectural Services, PLLC

608 S. 12th Street McAllen, Texas 78501

Phone: 956-688-5656 Fax: 956-687-9289 Website: www.milnet-archservices.com Project No. 224004

Set No:

Division	Section Title	Pages
DIVISION	00 - PROCUREMENT AND CONTRACTING REQUIREMENTS	<u>U</u>
DIVISION	01 - GENERAL REQUIREMENTS	
01 11 00	SUMMARY	1
01 20 00	PRICE AND PAYMENT PROCEDURES	2
01 21 00	ALLOWANCES	2
01 25 00	SUBSTITUTION PROCEDURES	3
01 30 00	ADMINISTRATIVE REQUIREMENTS	3
01 33 00	SUBMITTALS	4
01 35 16	ALTERATION PROJECT PROCEDURES	3
01 40 00	QUALITY REQUIREMENTS	2
01 50 00	TEMPORARY FACILITIES AND CONTROLS	5
01 73 29	CUTTING AND PATCHING	3
01 77 00	CLOSEOUT PROCEDURES	6
DIVISION	102 EXISTING CONDITIONS	
02 41 19	SELECTIVE DEMOLITION	2
02 41 19	Selective Demolition	2
DIVISION	03 - CONCRETE	
03 35 00	POLISHED CONCRETE FINISHING	6
DIVISION	104 MASONDV	
04.05.13	MORTAR	3
04 05 15	DDICK	5
04 22 00	CONCRETE MASONRY UNITS	5
0122.00		5
DIVISION	05 - METALS	
05 41 00	LIGHT GAGE METAL FRAMING SYSTEMS AND GYPSUM SHEATHING	4
DIVISION	UNG - WOOD AND PLASTICS	
06 10 00	ROUGH CARDENTRV	3
06 16 43	GVPSUM SHEATHING	3
06 40 23	INTERIOR ARCHITECTURAL WOODWORK	12
06 61 16	SOLID SURFACING	5
00 01 10	Solid Soli Acivo	5
DIVISION	07 - THERMAL AND MOISTURE PROTECTION	
07 21 00	BUILDING INSULATION	4
07 92 00	JOINT SEALANTS	2
DIVISION	108 - DOORS AND WINDOWS	
08 11 13	HOLLOW METAL DOORS & FRAMES	9
08 14 16	FLUSH WOOD DOORS	י ד
08 41 13	ALUMINIM STORFFRONT	/ &
08 71 00	FINISH HARDWARF	18
08 81 00	GLASS AND GLAZING	10
00 01 00	OLASS AND OLALING	4
DIVISION	09 - FINISHES	
09 21 16	INTERIOR DRYWALL SYSTEMS	8

09 30 00	WALL AND FLOOR TILE	5		
09 50 00	FELTWORKS™ BLADES (EBBS & FLOWS) ACOUSTICAL PANELS	e		
09 50 01	SOUNDSCAPES SHAPES ACOUSTICAL CLOUDS AND WALL PANELS	5		
09 51 00	ACOUSTICAL TILE CEILING	4		
09 65 13	RESILIENT WALL BASE AND ACCESSORIES	2		
09 91 00	PAINTING AND FINISHING	5		
DIVISION	10 – SPECIALTIES			
10 11 23	GLASS MARKERBOARD	2		
10 14 00	GRAPHICS AND SIGNAGE	۷		
10 44 00	FIRE EXTINGUISHERS AND CABINETS	3		
DIVISION 11 – EQUIPMENT				

- **DIVISION 12 FURNISHINGS**
- **DIVISION 13 SPECIAL CONSTRUCTION**
- **DIVISION 31 EARTHWORK**
- **DIVISION 32 EXTERIOR IMPROVEMENTS**
- **DIVISION 33 UTILITIES**

END OF TABLE OF CONTENTS



3/6/2025

DIVISION 21 – FIRE PROTECTION

21 13 13 WET-TYPE SPRINKLER SYSTEMS

DIVISION 22 – PLUMBING

- 22 00 00 SUMMARY OF PLUMBING WORK
- 22 05 00 COMMON WORK RESULTS FOR PLUMBING
- 22 05 29 HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT
- 22 05 53 IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT
- 22 07 19 PLUMBING PIPING INSULATION
- 22 11 16 DOMESTIC WATER PIPING
- 22 11 19 DOMESTIC WATER PIPING SPECIALTIES
- 22 13 13 FACILITY SANITARY SEWERS
- 22 13 19 SANITARY WASTE PIPING SPECIALTIES
- 22 33 00 ELECTRIC DOMESTIC WATER HEATERS
- 22 42 00 COMMERCIAL PLUMBING FIXTURES
- 22 47 13 DRINKING FOUNTAINS

DIVISION 23 – HEATING VENTILATION & AIRCONDITIONING

- 23 00 00 HEATING, VENTILATION AND AIR-CONDITIONING (HVAC)
- 23 05 00 COMMON WORK RESULTS FOR HVAC
- 23 05 29 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
- 23 05 63 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
- 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC
- 23 07 13 DUCT INSULATION
- 23 09 23 DIRECT DIGITAL CONTROL SYSTEM FOR HVAC
- 23 23 00 REFRIGERANT PIPING
- 23 26 00 CONDENSATE DRAIN PIPING
- 23 31 13 METAL DUCTS
- 23 33 00 HVAC DUCT ACCESSORIES
- 23 33 46 FLEXIBLE DUCTS
- 23 34 16 CENTRIFUGAL HVAC FANS
- 23 37 13 DIFFUSERS, REGISTERS AND GRILLES
- 23 73 12 DX AIR-HANDLING UNITS, SINGLE ZONE VAV

DIVISION 26/27/28 - ELECTRICAL

- 26 00 00 ELECTRICAL
- 26 00 01 ELECTRICAL GENERAL REQUIREMENTS
- 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL
- 26 05 19 LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES







- 26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
- 26 05 29 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
- 26 05 33 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
- 26 05 43 UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS
- 26 05 53 IDENTIFICATION FOR ELECTRICAL SYSTEMS
- 26 05 73.13 SHORT CIRCUIT STUDIES
- 26 05 73.19 ARC-FLASH HAZARD ANAYSIS
- 26 09 23 LIGHTING CONTROL SYSTEM
- 26 24 16 PANELBOARDS
- 26 27 26 WIRING DEVICES
- 26 28 13 FUSES
- 26 28 16.16 ENCLOSED SWITCHES
- 26 43 13 SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS
- 26 51 00 INTERIOR LIGHTING
- 26 56 00 EXTERIOR LIGHTING
- 27 05 33 CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS
- 28 31 00 INTRUSION DETECTION
- 28 31 11 ADDRESSABLE FIRE-ALARM SYSTEMS

SECTION 01 11 00 - SUMMARY

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 SUMMARY OF WORK

- A. Project Identification: As follows:
 - 1. Project: Edinburg Transit Terminal Interior Build-Out
 - 2. Owner: Edinburg Economic Development Corporation
 - 3. Location: 617 University Dr., Edinburg, TX 78539
- B. Contract Documents dated <u>March 12, 2025</u> were prepared by Milnet Architectural Services, 608 S. 12th St. McAllen, TX. 78501.
- C. The Work consists of a 4,133 Sq. Ft. interior build-out for the new offices for Edinburg Economic Development Corporation which include office spaces, meetings rooms, restrooms and a breakroom.

1.3 WORK RESTRICTIONS

- A. Contractor's Use of Premises: During construction, Contractor shall have **limited** use of **site** indicated. Contractor's use of premises is limited only by Owner's right to perform work or employ other contractors on portions of Project.
- B. Assume full responsibility for the protection and safekeeping of Products under this Contract, stored on the site.
- C. Move any stored Products, under Contractor's control, which interfere with operations of the Owner and separate contractor.
- PART 2 PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

SECTION 01 20 00 - PRICE AND PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 UNIT PRICES

A. Changes to the Work incorporating Unit Prices will be made by Change Order.

1.3 CONTRACT MODIFICATION PROCEDURES

- A. On Owner's approval of a proposal from Contractor, Architect will issue a Change Order on AIA Document G701, for all changes to Contract Sum or Contract Time.
- B. When Owner and Contractor disagree on the terms of a proposal, Architect may issue a Construction Change Directive on AIA Document G714, instructing Contractor to proceed with the change. Construction Change Directive will contain a description of the change and designate the method to be followed to determine changes to Contract Sum or Contract Time.

1.4 PAYMENT PROCEDURES

- A. Submit a Schedule of Values <u>at least 10 days before</u> the first Application for Payment. In Schedule of Values, break down Contract Sum into at least one line item for each Specification Section, showing both material and labor. Correlate the Schedule of Values with Contractor's Construction Schedule.
- B. Submit 3 copies of each application for payment on AIA Document G702/703, according to the schedule established in Owner/Contractor Agreement.
 - 1. For the second Application for Payment through the Application for Payment submitted at Substantial Completion, submit partial releases of liens from each subcontractor or supplier for whom amounts were requisitioned in the previous Application for Payment.
 - 2. Contractor shall submit along with each Application for Payment, any proposed delay days, rain/weather days, additional general conditions incurred and an updated construction schedule.
 - 3. The Architect will not review or consider approval of any proposed delay days or additional general conditions incurred that are not submitted within **ten (10) calendar days** of said event(s) taking place.

4. Submit final Application for Payment after completion of Project closeout procedures with release of liens and supporting documentation. Include consent of surety to final payment and insurance certificates.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

SECTION 01 21 00 — ALLOWANCES

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 RELATED DOCUMENTS

A. Section 01 20 00 – Price and Payment Procedures.

1.3 CONTINGENCY ALLOWANCE

A. Include in the Contract, a stipulated sum of Seventy Thousand, three hundred twenty-five Dollars, (\$70,325.00) for use upon Architect's instruction.

1.4 PROCEDURES FOR MANAGING ALLOWANCES

- A. Contractor's costs for Products, delivery, installation, labor, payroll, taxes, bonding, and equipment rental will be included in Construction Change Directives authorizing expenditure of funds from Allowances.
- B. Funds will be drawn from Allowances only by Construction Change Directives.
- C. At closeout of Contract, funds remaining in Allowances will be credited to Owner by Change Order.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

SECTION 01 25 00 – SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 SUBSTITUTION REQUIREMENTS

- A. When material, article, or method is specified using name of proprietary product manufacturer, vendor, or method followed by phrase "or equal," specific item mentioned establishes basis upon which projects are to be built.
 - 1. Other manufacturers' materials, articles, and methods not named will be considered as substitutions provided required information is submitted on "SUBSTITUTION REQUEST FORM" and will not require substantial revisions of Contract Documents.
 - 2. This applies to specific construction methods when required by Contract Documents.
 - 3. Substitution Requests must be filled out on enclosed "Substitution Request Form".
- B. Whenever material, article, or method is specified or described without phrase "or equal," no substitutions will be allowed.
- C. Costs for redesigns due to substituted items are responsibility of Applicant.
- D. In making request for substitution, Applicant/Contractor represents that he:
 - 1. Has personally investigated proposed product or method and determined that it is equal in all respects to that specified.
 - 2. Will provide same guarantee for substitution as for product or method specified.
 - 3. Will coordinate installation of accepted substitution into work, making design and construction changes to complete work in all respects following the Contract Documents.

1.3 SUBMITTAL OF DATA FOR PROPOSED SUBSTITUTIONS

A. In order for substitutions that do not change design intent to be considered, submit no later than 10 days prior to bid date deadline, 3 copies of complete data set forth herein to permit complete analysis of proposed substitutions listed on submitted "SUBSTITUTION REQUEST FORM".

- 1. For Products:
 - a. Identification including manufacturer's name and address.
 - b. Manufacturer's literature, including but not necessarily limited to:
 - 1) Product description, performance, and test data.
 - 2) Reference standards.
 - c. Samples where appropriate.
 - d. Name and address of similar projects on which product was used and dates of installation with contact name and telephone number.
- 2. For Construction Methods:
 - a. Detailed description of proposed method.
 - b. Drawings illustrating methods.
 - c. Name and address of similar projects on which method was used and dates of use with contact name and telephone number.
- 3. Comparison of proposed substitution with product or method specified
- 4. Data relating to impact on construction schedule by proposed substitution.
- 5. Impact on other contracts.

1.4 APPROVAL OF SUBSTITUTION

- A. Architect's decision regarding evaluation of substitutions will be final and binding.
- B. All approved substitutions will be incorporated into the Contract Documents by Addendum.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

SUBSTITUTION REQUEST FORM

Project:	Substitution Request Number:
	From:
То:	Date:
	A/E Project Number:
Re:	Contract For:
Specification Title:	Description:
Section: Page:	Article/Paragraph:
Proposed Substitution:	
Manufacturer: Address: Trade Name:	Phone: Model No.:
Attached data includes product description, specif	
Attached data also includes a description of changinstallation.	ges to the Contract Documents that the proposed substitution will require for its proper
Proposed substitution will have no adverse eff Proposed substitution does not affect dimensie Payment will be made for changes to buil substitution. Submitted by: Signed by: Firm: Address:	Fect on other trades and will not affect or delay progress schedule. ons and functional clearances. Iding design, including A/E design, detailing, and construction costs caused by the
Telephone:	
A/E's REVIEW AND ACTION	
 Substitution approved - Make submittals in acc Substitution approved as noted - Make submitta Substitution rejected - Use specified materials. Substitution Request received too late - Use specified 	cordance with Specification Section 01340 Submittals als in accordance with Specification Section 01340 Submittals ecified materials.
Signed by:	Date:
Supporting Data Attached: 🗌 Drawings	Product Data Samples Tests Reports
END OF SECTION	
SUBSTITUTION PROCEDURES	8/9/2024 01 25 00 - 3

SECTION 01 30 00 - ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 PROJECT MANAGEMENT AND COORDINATION

- A. Verify layout information shown on Drawings, in relation to property survey and existing benchmarks, before laying out the Work.
- B. Coordinate construction to ensure efficient and orderly execution of each part of the Work.
- C. Progress meetings will be held at Project site every two weeks. Notify Owner and Architect of meeting dates. Each subcontractor or other entity concerned with current progress or involved with planning or coordination of future activities, shall attend. The Contractor shall:
 - 1. Prepare a progress meeting agenda.
 - 2. Prepare a sign in sheet for each progress meeting.
 - 3. Prepare minutes of each meeting and distribute to parties present.

1.3 CONSTRUCTION SCHEDULE

- A. Prepare a horizontal bar-chart construction schedule. Provide a separate time bar for each activity and a vertical line to identify the first workday of each week. Use same breakdown of Work indicated in the Schedule of Values. As Work progresses, mark each bar to indicate actual completion.
 - 1. Submit within twenty (20) days after date established for Commencement of the Work.
 - 2. Coordinate each element with other activities. Show each activity in proper sequence. Indicate sequences necessary for completion of related Work.
 - 3. Indicate Substantial Completion and allow time for Architect's procedures necessary for certifying Substantial Completion.
 - 4. Schedule Distribution: Distribute copies to Owner, Architect, subcontractors, and parties required to comply with dates.

5. Updating: Revise the schedule after each meeting or activity where revisions have been made. Distribute revised copies to Owner, Architect, subcontractors, and parties required to comply with dates.

1.4 SUBMITTAL PROCEDURES

- A. Coordinate submittal preparation with construction schedule, fabrication lead-times, other submittals, and activities that require sequential operations.
 - 1. No extension of Contract Time will be authorized due to failure to transmit submittals in time to permit processing sufficiently in advance of when materials are required in the Work.
 - 2. Architect will not accept submittals from sources other than Contractor.
- B. Prepare submittals by placing a permanent label on each for identification. Provide a 4 by 5 inch space on the label or beside title block to record review and approval markings and action taken. Include the following information on the label:
 - 1. Project name.
 - 2. Date.
 - 3. Name and address of Contractor.
 - 4. Name and address of subcontractor or supplier.
 - 5. Number and title of appropriate Specification Section.
 - 6. Contractor's certification that materials comply with specified requirements.
- C. Coordinate each submittal with other submittals and with work that does not require submittals.
- D. Product Data: Mark each copy to show applicable choices and options. Include the following:
 - 1. Data indicating compliance with specified standards and requirements.
 - 2. Notation of coordination requirements.
 - 3. For equipment data, include rated capacities, dimensions, weights, required clearances, and furnished specialties and accessories.
- E. Shop Drawings: Submit newly prepared information drawn to scale. Do not reproduce Contract Documents or copy standard information. Submit 1 reproducible print and 1 blue- or black-line print on sheets at least 8-1/2 by 11 inches but no larger than 30 by 42 inches. Architect will return the reproducible print. Include the following:
 - 1. Dimensions, profiles, methods of attachment, coordination with adjoining work, large scale details, and other information, as appropriate for the Work.
 - 2. Identification of products and materials.
 - 3. Notation of coordination requirements.
 - 4. Notation of dimensions established by field measurement.
 - 5. Identification of deviations from Contract Documents.
- F. Samples: Submit Samples finished as specified and identical with the material proposed. Where variations are inherent in the material, submit sufficient units to show limits of the variations. Include product name or name of the manufacturer.
- G. Architect will review each submittal, mark as appropriate to indicate action taken, and return copies less those retained. Compliance with specified requirements remains Contractor's responsibility.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

SECTION 01 33 00 - SUBMITTALS

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 WORK INCLUDED

A. Provide shop drawings, product data, physical samples and color samples as indicated herein and in each technical section of these specifications.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Additional submittal requirements specific to the particular section of the specifications.

PART 2 - PRODUCTS

2.1 SHOP DRAWINGS

- A. Prepare shop drawings using competent draftsmen, clearly and precisely showing the following:
 - 1. The size and gage of members.
 - 2. The method of anchoring and securing members of parts together.
 - 3. The quantity and location of each item.
 - 4. Other pertinent data necessary to show the Work to be done and where and how it is to be done.
- B. Prepare Drawings to scale, including full size details as required to fix and illustrate the Work required. Do not use Contract Documents or reproductions thereof as shop drawing submittals.
- C. Each sheet of Drawings shall be 30 x 40 inches maximum size with borders. Provide a title block in the lower right hand corner with the following information:
 - 1. Title of the sheet.
 - 2. Name and location of Project.
 - 3. Names of:
 - a. Architect/Engineer.
 - b. General Contractor.
 - c. Manufacturer of the specified materials and equipment.

- 4. The date of the Submittal.
- 5. The date of each correction or revision.
- 6. **Submittal number including Division No.** (such as submittal no. 3 under Division 11 is numbered "11-03").
- D. Fold drawings to 8-1/2x11 inch dimensions with title block exposed to top.
- E. Check the Drawings and add any corrections of field measurements needed. Stamp and sign the Contractor's approval, checker's signature, and date of approval before submitting to the Architect. Shop Drawings which do not bear the Contractor's stamp or have not been reviewed by the Contractor, will be returned by the Architect without review or approval.
- F. Number Shop Drawings consecutively. Indicate working and erection dimensions, arrangements, sectional views, necessary details including complete information for making connections with other Work, kinds of materials, and finishes.
- G. Provide a transmittal letter in duplicate, pointing out any deviations from items, methods or named manufacturers included in the Specifications or on the Drawings. Note submittal file number including Division.
- H. Submit <u>six (6)</u> blue line prints of each Shop Drawing sheet.
- I. Make such corrections, changes, resubmit bound sets of Shop Drawings prints, as required herein, until approved is obtained. Any corrections or changes indicated on Shop Drawings shall not be considered as an extra work order.

2.2 PHYSICAL SAMPLES

- A. Provide duplicate samples of items as specified. Samples shall be 12 inches square or 12 inches long unless noted otherwise. Minimum liquid samples shall be 1 pint. Installed materials shall match approved samples.
- B. For Architect's permanent files provide one (1) 6" x 6" sample of all interior finishes, colors and materials (aluminum finish, glazing, plastic laminate, paint finish flooring materials, ceiling finish, etc.)
- C. Provide a transmittal letter with each sample, listing the following:
 - 1. Specification section title and paragraph specifying the material.
 - 2. Name and location of Project.
 - 3. Names of:

4.

- a. Architect/Engineer.
- b. General Contractor.
- c. Manufacturer of the specified materials and equipment.
- The date of the Submittal.
- 5. Submittal file number including Division.
- D. If samples are not acceptable they will be returned directly to the Contractor for modification and resubmission.
- E. If samples are acceptable, notification will be sent directly to the Contractor, and the sample retained for comparison with the complete Work.

2.3 MANUFACTURER'S PRODUCT DATA

- A. Provide <u>six (6)</u> copies of pre-printed Product Data of items as specified. Carefully mark out all items not applicable to the specified item.
- B. Standard catalogs, brochures, etc. including information not applicable to the project and not marked through, will be returned without review or approval.
- C. Provide a transmittal letter with the Product Data from each manufacturer, listing the following information:
 - Name and location of Project.
 - 2. Names of:

1.

- a. Architect/Engineer.
- b. General Contractor.
- c. Manufacturer of the specified materials and equipment.
- 3. The date of the Submittal.
- 4. Submittal file number including Division.
- D. If Product Data is not approved, one copy will be marked and returned directly to the Contractor for modification and resubmission.
- E. If Product Data is approved, notification and one copy of the acceptable Product Data will be sent directly to the Contractor.
- F. When requested by the Architect, provide six (6) copies of each ASTM Federal Specification, or other applicable documents referenced in the material Section.

PART 3 - EXECUTION

3.1 REVIEW PROCEDURE

- A. Submittals will be reviewed with reasonable promptness so as to cause no delay, but only for conformance with the design concept of the project and with the information given in the Contract Documents. Architect shall be allowed a maximum review period of <u>fourteen (14)</u> calendar days. The review of a separate item shall not indicate a review of an assembly in which the item functions. Submittals that contain excessive errors or that are incomplete will be returned without review and approval and any delay caused thereby shall be the responsibility of the Contractor.
- B. If any submittals are not approved as submitted, all copies will be returned directly to the Contractor for revision. The reviewed submittals will be returned to the Contractor as soon as practicable.
- C. The Contractor shall make all revisions as noted and shall resubmit the required number of corrected copies of submittals, until no exceptions are taken. The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, to revisions other than those requested on previous submissions.
- D. The review of submittals shall not relieve the Contractor of responsibility for deviations from the requirements of the Contract Documents unless the Contractor has submitted, in writing, such deviations and written approval has been given to each specific deviation. The review shall not relieve the Contractor from responsibility for errors and omissions in the Shop Drawings and samples.

- E. No portion of the Work requiring a submittal shall commence until the submittal has been approved as designated in the Conditions of the Contract. All such portions of the Work shall be in accordance with the submittal that has been stamped with final "Reviewed Without Exceptions" note, or "Approved" note.
- F. Materials and equipment specified or approved prior to beginning the Work are required to be used on the Project. Any proposed substitution resulting from no availability of specified items must be proven "better than" by the Contractor and approved in writing by the Architect. Substitutions included in submittals shall be so noted and brought to the Architect's attention in the submittal and on the transmittal. Failure to follow this procedure will render the substitution as not acceptable whether or not reviewed by the Architect.
- G. The Contractor shall have the approved shop drawings at the site at all times for use in the construction of the Work. Failure of the Contractor to supply such drawings will be deemed sufficient cause to delay the Work until such drawings are available for field use and reference.
- H. For submittals that will be reviewed by one of the Architect's consultants, these submittals shall be delivered directly to the Architect. The Architect will then be responsible to provide the Consultant with a copy of the submittal.
- I. For submittals that will be reviewed by one of the Architect's consultants, do not send to the Consultant as part of the package any items which will be reviewed by the Architect. As an example, do not provide a single submittal package combining Structural Steel and Miscellaneous Metal Fabrications.

SECTION 01 35 16 — ALTERATION PROJECT PROCEDURES

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 SECTION INCLUDES

- A. Products and installation for patching and extending Work.
- B. Transition and adjustments.
- C. Repair of damaged surfaces, finishes, and cleaning.

1.3 RELATED SECTIONS

- A. Section 01 11 00 Summary: Work sequence and Phasing.
- B. Section 01 73 29 Cutting and Patching: Requirements and limitations for cutting and patching of work.
- C. Section 01 50 00 Temporary Facilities and Controls: Temporary enclosures, protection of installed work, and cleaning during construction.

PART 2 - PRODUCTS

2.1 PRODUCTS FOR PATCHING AND EXTENDING WORK

- A. New Materials: As specified in product sections; match existing Products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing Products where necessary, referring to existing Work as a standard.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that demolition is complete and areas are ready for installation of new Work.
- B. Beginning of restoration Work means acceptance of existing conditions.

3.2 PREPARATION

- A. Cut, move, or remove items as necessary for access to alterations and renovation Work. Store items scheduled for reinstallation. Replace and restore at completion.
- B. Remove unsuitable material not marked for salvage, such as rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for finished Work.
- C. Remove debris and abandoned items from area and from concealed spaces.
- D. Prepare surface and remove surface finishes to provide for proper installation of new work and finishes.
- E. Close openings in exterior surfaces to protect existing work, salvaged, and stored items from weather and extremes of temperature and humidity. Temporarily seal wall cavities and substrates exposed by cutting, patching, and demolition work to prevent accumulation and trapping of moisture which will allow the development of mildew.

3.3 INSTALLATION

- A. Coordinate work of alterations and renovations to expedite completion sequentially. Do not remove existing items which weatherproof buildings (windows, roofing, doors, exterior finishes etc.) until new materials and items are ready for installation.
- B. Remove, cut, and patch Work in a manner to minimize damage and to provide a means of restoring products and finishes to specified condition. Refinish visible existing surfaces to remain in renovated rooms and spaces, to specified condition for each material, with a neat transition to adjacent finishes, in accordance with Section 01 73 29 Cutting and Patching.
- C. Install Products as specified in individual sections.

3.4 TRANSITIONS

- A. Where new Work abuts or aligns with existing, perform a smooth and even transition. Patch Work to match existing adjacent Work in texture and appearance.
- B. When finished surfaces are cut so that a smooth transition with new Work is not possible, terminate existing surface along a straight line at a natural line of division. Consult Architect for direction on making transitions.

3.5 ADJUSTMENTS

- A. Where removal of partitions or walls result in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
- B. Fit work at penetrations of surfaces as specified in Section 01 73 29 Cutting and Patching.

3.6 REPAIR OF DAMAGED SURFACES

- A. Patch or replace portions of existing surfaces which are damaged, lifted, discolored, or showing other imperfections.
- B. Repair substrate prior to patching finish.

3.7 FINISHES

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

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 SECTION REQUIREMENTS

- A. Quality-control services include inspections, tests, and related actions including reports. Quality-control services are further specified in other Sections of these Specifications and shall be performed by independent testing agencies provided by Contractor or Owner, as specified.
 - 1. Unless otherwise indicated, quality-control services required by authorities having jurisdiction will be provided by Owner.
- B. Contractor is responsible for scheduling inspections and tests.

C. Retesting: Contractor shall pay for retesting where results of inspections and tests prove unsatisfactory and indicate noncompliance with requirements.

- D. Auxiliary Services: Cooperate with agencies performing inspections and tests. Provide auxiliary services as requested. Notify agency in advance of operations requiring tests or inspections, to permit assignment of personnel. Auxiliary services include the following:
 - 1. Access to the Work.
 - 2. Incidental labor and facilities to assist inspections and tests.
 - 3. Adequate quantities of materials that require testing, and assisting in taking samples.
 - 4. Facilities for storage and curing of test samples.
 - 5. Security and protection of samples and test equipment.
- E. Duties of Testing Agency: Testing agency shall cooperate with Architect and Contractor in performing its duties. Agency shall provide qualified personnel to perform inspections and tests.
 - 1. Agency shall promptly notify Architect and Contractor of irregularities or deficiencies observed in the Work during performance of its services.
 - 2. Agency shall not release, revoke, alter, or enlarge requirements of the Contract Documents or approve or accept any portion of the Work.
 - 3. Agency shall not perform duties of Contractor.

- F. Submittals: Testing agency shall submit a certified written report of each inspection and test to the following:
 - 1. Owner.
 - 2. Architect.
 - 3. Contractor.
 - 4. Structural engineer.
 - 5. Authorities having jurisdiction, when authorities so direct.
- G. Report Data: Reports of each inspection, test, or similar service shall include at least the following:
 - 1. Name, address, and telephone number of testing agency.
 - 2. Project title and testing agency's project number.
 - 3. Designation (number) and date of report.
 - 4. Dates and locations where samples were taken or inspections and field tests made.
 - 5. Names of individuals taking the sample or making the inspection or test.
 - 6. Designation of the product and test method.
 - 7. Complete inspection or test data including an interpretation of test results.
 - 8. Ambient conditions at the time of sample taking and testing.
 - 9. Comments or professional opinion on whether inspected or tested Work complies with requirements.
 - 10. Recommendations on retesting or reinspection.
 - 11. Name and signature of laboratory inspector.
- H. Testing Agency Qualifications: Engage inspection and testing agencies that are prequalified as complying with the American Council of Independent Laboratories' "Quality Assurance Manual" and that specialize in the types of inspections and tests to be performed.
 - 1. Each testing agency shall be authorized by authorities having jurisdiction to operate in the state where Project is located.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

SECTION 01 50 00 — TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 SECTION INCLUDES

- A. Temporary Utilities: Electricity, lighting, heat, ventilation, telephone and fax service, water, and sanitary facilities.
- B. Temporary Controls: Barriers, enclosures and fencing, protection of the Work, and water control.
- C. Construction Facilities: Parking, progress cleaning, project signage and temporary buildings.

1.3 TEMPORARY ELECTRICITY

- A. Cost: By General Contractor. Utilize existing power service if approved by Owner. Extend temporary outlets in NEC and OSHA approved manner to facilitate construction. If existing power service usage is approved by the Owner, the Contractor shall reimburse the Owner for the dollar amount of electrical consumption during the course of construction.
- B. Provide power outlets for construction operations, with branch wiring and distribution boxes located as required. Provide flexible power cords as required.
- C. Provide main service disconnect and over correct protection at convenient location.
- D. Provide sufficient and adequate distribution equipment, wiring, and outlets to ensure unimpeded progress of the Work.
- E. Permanent convenience receptacles may be utilized during construction.

1.4 TEMPORARY LIGHTING

A. Provide and maintain lighting for construction operations to achieve a minimum lighting level of 2 watt/sq ft.

- B. Provide and maintain 1 watt/sq ft lighting to exterior staging and storage areas after dark for security purposes.
- C. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.
- D. Permanent building lighting may be utilized during construction.
- E. Maintain lighting and provide routine repairs.

1.5 TEMPORARY HEAT

- A. Provide and pay for heating devices and heat as needed to maintain specified conditions for construction operations.
- B. Maintain minimum ambient temperature of 50 degrees F (10 degrees C) in areas where construction is in progress, unless indicated otherwise in product sections.

1.6 TEMPORARY COOLING

A. If required for the proper installation of particular materials, systems, or equipment, provide and pay for cooling devices and cooling as needed to maintain specified conditions.

1.7 TEMPORARY VENTILATION

- A. Ventilate enclosed areas to assist cure of materials, to dissipate humidify, and to prevent accumulation of dust, fumes, vapors, or gases.
- B. Utilize existing ventilation equipment if approved by Owner. Extend and supplement equipment with temporary fan units as required to maintain clear air for construction operations.

1.8 TELEPHONE SERVICE

A. Provide, maintain and pay for telephone service to field office.

1.9 FACSIMILE SERVICE

A. Provide, maintain and pay for separate telephone line to be used solely for fax service to field office.

1.10 TEMPORARY WATER SERVICE

- A. Utilize existing water service if approved by Owner for construction operations. If existing water service usage is approved by the Owner, the Contractor shall reimburse the Owner for the dollar amount of water consumption during the course of construction.
- B. Extend branch piping with outlets located so water is available by hoses with threaded connections. Provide temporary pipe insulation to prevent freezing as required.

1.11 TEMPORARY SANITARY

A. Provide and maintain required facilities and enclosures. Existing facility use is **not** permitted. Provide at time of project mobilization.

1.12 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas to protect existing facilities and adjacent properties from damage from construction operations and demolition. Barriers must isolate occupied use from construction activities. If and when needed, barriers must be capable of attenuating sound.
- B. Provide protection for existing plant life and landscaped. Maintain plant life and landscaped areas as necessary during construction operations. Replace damaged plant life.
- C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.
- D. Barrier plan and method subject to approval by the Architect and the Owner.

1.13 FENCING

- A. Construction: Commercial grade chain link fence.
- B. Provide 6 foot high fence around construction site, equip with vehicular and pedestrian gates with locks. Fence must be capable of restricting entry by on-site facility users.

1.14 EXTERIOR ENCLOSURES

- A. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protect for products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.
- B. Provide temporary protection of existing wall cavities, substrates, and surfaces exposed to weather during cutting and minor demolition operations to prevent entrapment of moisture and development of mildew.

1.15 PROTECTION OF INSTALLED WORK

- A. Protect installed Work and provide special protection to prohibit damage and where specified in individual specification sections.
- B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to minimize damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Protect finished 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 upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

F. Prohibit traffic in all landscaped areas.

1.16 SECURITY

- A. Provide security and facilities to protect Work and existing facilities from unauthorized entry, vandalism, or theft.
- B. Coordinate project security program with Owner's existing security operations at project mobilization.
- C. Maintain program throughout construction period until Owner acceptance precludes the need for Contractor security.
- D. Restrict entrance of persons and vehicles into Project site and existing facilities, allowing entrance only to authorized persons and persons identified by the Contract Document and/or the Architect or Owner as authorized to visit Project site.

1.17 ACCESS

- A. Provide and maintain temporary roads accessing public thoroughfares to serve construction area.
- B. Extend and relocate as work progress requires. Provide detours necessary for unimpeded traffic flow.
- C. Provide and maintain access to fire hydrants, free of obstructions.
- D. Provide means of removing mud from vehicle wheels before entering streets.

1.18 PARKING

- A. Provide temporary surface parking areas to accommodate construction personnel. Existing site areas may be used if approved in advance by the Owner.
- B. Contractor to propose plan for Owner concurrence and approval.

1.19 PROGRESS CLEANING AND WASTE REMOVAL

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and rubbish from site weekly and dispose off-site.

1.20 PROJECT IDENTIFICATION

A. Provide project sign. Refer to drawings for size and content.

- B. Erect on site at location established by Architect.
- C. No other signs are allowed without Owner permission except those required by law.

1.21 FIELD OFFICES AND SHEDS

- A. Office: Weather tight with lighting, electrical outlets, heating, cooling and ventilating equipment, and equipped with sturdy furniture drawing rack, and drawing display table, phone and fax.
- B. Provide space for Project meetings, with table and chairs to accommodate 6 persons.
- C. Provide storage sheds and facilities to accommodate Work. Size to storage requirements for products of individual Sections, allowing for access and orderly provision for maintenance and for inspection of products to requirements of Section 01 25 00.
- D. Designated existing covered and uncovered hard paved areas and facilities may be used for field storage areas. Protect and secure existing areas used for storage. Upon completion of Work, clean, repair, and restore all existing areas used for storage and restore to acceptable condition.

1.22 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, materials prior to Substantial Completion.
- B. Remove underground installation to a minimum depth of 2 feet. Grade site to drain.
- C. Clean and repair damage caused by installation or use of temporary work.
- D. Restore existing and permanent facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

SECTION 01 73 29 — CUTTING AND PATCHING

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 SECTION INCLUDES

A. Requirements and limitations for cutting and patching of Work.

1.3 RELATED SECTIONS

- A. Section 01 10 00 Summary: Work by Owner or by separate Contractors.
- B. Section 01 35 16 Alteration Project Procedures.
- C. Section 01 25 00 Substitution Procedures.
- D. Individual Product Specification Sections:
 - 1. Cutting and patching incidental to work of the section.
 - 2. Advance notification to other sections of openings required in work of those sections.
 - 3. Limitations on cutting structural members.

1.4 SUBMITTALS

- A. Submit written request in advance of cutting or alteration which affects:
 - 1. Structural integrity of any element of Project.
 - 2. Integrity of weather exposed or moisture resistant element.
 - 3. Efficiency, maintenance, or safety of any operational element.
 - 4. Visual qualities of sight exposed elements.
 - 5. Work of Owner or separate Contractor.
- B. Include in request:
 - 1. Identification of Project.
 - 2. Location and description of affected Work.
 - 3. Necessity for cutting or alteration.
 - 4. Description of proposed Work and Products to be used.

- 5. Alternatives to cutting and patching.
- 6. Effect on work of Owner or separate Contractor.
- 7. Written permission of affected separate Contractor.
- 8. Date and time work will be executed.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Primary Products: Those required for original installation.
- B. Product Substitution: For any proposed change in materials, submit request for substitution in accordance with Section 01 25 00 Substitution Procedures.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine existing conditions prior to commencing Work, including elements subject to damage or movement during cutting and patching.
- B. After uncovering existing Work, assess conditions affecting performance of work.
- C. Beginning of cutting or patching means acceptance of existing conditions.

3.2 PREPARATION

- A. Provide temporary supports to ensure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage.
- B. Provide protection from elements for areas which may be exposed by uncovering work. Avoid unnecessary or extended exposure to weather of work exposed by cutting. Avoid entrapment of moisture or other deleterious mater between existing substrates and new work.
- C. Maintain excavations free of water.

3.3 CUTTING

- A. Execute cutting and fitting including excavation and fill to complete the Work.
- B. Uncover work to install improperly sequenced work.
- C. Remove and replace defective or non-conforming work.
- D. Remove samples of installed work for testing when requested.
- E. Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight-exposed surfaces.

F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

3.4 PATCHING

- A. Execute patching to complement adjacent Work.
- B. Fit Products together to integrate with other Work.
- C. Execute work by methods to avoid damage to other Work, and which will provide appropriate surfaces to receive patching and finishing.
- D. Employ skilled installer to perform patching for weather exposed and moisture resistant elements, and sight-exposed surfaces.
- E. Restore work with new Products in accordance with requirements of Contract Documents.
- F. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- G. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.

1.2 ACTION SUBMITTALS

- A. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- B. Certified List of Incomplete Items: Final submittal at Final Completion.

1.3 CLOSEOUT SUBMITTALS

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

1.4 MAINTENANCE MATERIAL SUBMITTALS

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

1.5 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction

photographic documentation, damage or settlement surveys, property surveys, and similar final record information.

- 3. Submit closeout submittals specified in individual Divisions 02 through 33 Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
- 4. Submit maintenance material submittals specified in individual Divisions 02 through 33 Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
- 5. Submit test/adjust/balance records.
- 6. Submit sustainable design submittals required in Division 01 sustainable design requirements Section and in individual Division 02 through 33 Sections.
- 7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Advise Owner of pending insurance changeover requirements.
 - 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 - 3. Complete startup and testing of systems and equipment.
 - 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 - 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Division 01 Section "Demonstration and Training."
 - 6. Advise Owner of changeover in heat and other utilities.
 - 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 - 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 - 9. Complete final cleaning requirements, including touchup painting.
 - 10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
 - 1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 - 2. Results of completed inspection will form the basis of requirements for final completion.

1.6 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
 - 1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
 - 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 - 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 - 4. Submit pest-control final inspection report.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
 - 1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.7 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 - 1. Organize list of spaces in sequential order.
 - 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 - 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.
 - 4. Submit list of incomplete items in the following format:
 - a. MS Excel electronic file. Architect will return annotated file.

1.8 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

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

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
 - 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
- c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
- d. Remove tools, construction equipment, machinery, and surplus material from Project site.
- e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
- f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
- g. Sweep concrete floors broom clean in unoccupied spaces.
- h. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
- i. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
- j. Remove labels that are not permanent.
- k. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
- 1. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
- m. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
- n. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - 1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.
- o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
- p. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Division 01 Section "Temporary Facilities and Controls." Prepare written report.
- D. Construction Waste Disposal: Comply with waste disposal requirements in Division 01 Section "Temporary Facilities and Controls."

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
 - 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
 - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.

- a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
- 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
- 4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 SECTION REQUIREMENTS

- A. Unless otherwise indicated, demolished materials become Contractor's property. Remove from Project site.
- B. Items indicated to be removed and salvaged remain Owner's property. Remove, clean, and deliver to Owner's designated storage area.
- C. Comply with EPA regulations and disposal regulations of authorities having jurisdiction.
- D. Conduct demolition without disrupting Owner's use of the building.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 DEMOLITION

- A. Maintain and protect existing utilities to remain in service before proceeding with demolition, providing bypass connections to other parts of the building.
- B. Locate, identify, shut off, disconnect, and cap off utility services to be demolished.
- C. Employ a certified, licensed exterminator to treat building and to control rodents and vermin.
- D. Conduct demolition operations and remove debris to prevent injury to people and damage to adjacent buildings and site improvements.
- E. Provide and maintain shoring, bracing, or structural support to preserve building stability and prevent movement, settlement, or collapse.

- F. Protect building structure or interior from weather and water leakage and damage.
- G. Protect remaining walls, ceilings, floors, and exposed finishes. Erect and maintain dustproof partitions. Cover and protect remaining furniture, furnishings, and equipment.
- H. <u>Structural Elements</u>: Field verify existing conditions prior to undertaking any demolition activities. Contractor shall investigate existing conditions prior to commencing saw cutting activities, partial concrete removal, concrete coring, penetrations into existing slab and structural steel/wood framing removal or cutting.
- I. <u>Concrete Slab Demolition</u>: If the existing concrete slab is damaged during the course of demolition (post tension cabling damage, rebar damage, aggregate damage, soil disturbance, etc.) contractor shall cease demolition activities immediately and notify Architect. Contractor will be responsible to submit a plan for corrective work. This plan shall include a professional structural engineer's recommendation(s). All corrective work shall be at the expense of the General Contractor.
- J. <u>Structural and Framing Demolition</u>: If any existing structural elements are damaged during the course of demolition (beams, columns, wood framing, rebar, plates, angles, etc.) contractor shall cease demolition activities immediately and notify Architect. Contractor will be responsible to submit a plan for corrective work. This plan shall include a professional structural engineer's recommendation(s). All corrective work shall be at the expense of the General Contractor.
- K. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction.
- L. Promptly patch and repair holes and damaged surfaces of building caused by demolition. Restore exposed finishes of patched areas and extend finish restoration into remaining adjoining construction.
- M. Promptly remove demolished materials from Owner's property and legally dispose of them. Do not burn demolished materials.

SECTION 03 35 00 - POLISHED CONCRETE FINISHING

PART 1 GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 SECTION INCLUDES

- A. Polished concrete.
- B. Dyed and polished concrete.

1.3 RELATED SECTIONS

- A. Section 03 01 30 Maintenance of Cast-in-Place Concrete.
- B. Section 07 91 26 Joint Fillers.

1.4 REFERENCES

- A. American Concrete Institute (ACI): ACI 302.1R Guide for Concrete Floor and Slab Construction.
- B. American National Standards Institute (ANSI): Standards B-101.1/2009.
- C. ASTM International (ASTM):
 - 1. ASTM C 309 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - 2. ASTM C 171 Standard Specification for Sheet Materials for Curing Concrete.
 - 3. ASTM C 779 Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces.
- D. National Floor Safety Institute (NFSI): NFSI Test Method 101-A Standard for Evaluating High-Traction Flooring Materials.

1.5 SYSTEM DESCRIPTION

- A. Performance Requirements: Provide polished flooring that has been designed, manufactured and installed to achieve the following:
 - 1. Abrasion Resistance: ASTM C779, Method A, high resistance, no more than 0.008 inch (0.20 mm) wear in 30 minutes.
 - 2. Reflectivity: Increase of 35% as determined by standard gloss meter.
 - 3. Waterproof Properties: Rilem Test Method 11.4, 70% or greater reduction in absorption.

4. High Traction Rating: NFSI 101-A, ANSI B-101.1 2009 non-slip properties.

1.6 SUBMITTALS

- A. Submit under provisions of Section 01 30 00 Administrative Requirements.
- B. Shop Drawings: Indicate information on shop drawings as follows:
 - 1. Typical layout including dimensions and floor grinding schedule.
 - 2. Plan view of floor and joint pattern layout.
 - 3. Areas to receive colored surface treatment.
 - 4. Hardener, sealer, densifier identified in notes.
- C. Product Data: Submit product data, including manufacturer's SPEC-DATA product sheet, for specified products.
 - 1. Material Safety Data Sheets (MSDS).
 - 2. Preparation and concrete grinding procedures.
 - 3. Colored Concrete Surface, Dye Selection Guides.
- D. Quality Assurance Submittals:
 - 1. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties as cited in Performance Requirements.
 - 2. Certificates:
 - A. Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
 - B. Letter of certification from the National Floor Safety Institute confirming the system has been tested and passed phase Two Level of certification when tested by Method 101-A. ANSI B-101.1 2009 non-slip properties.
 - C. Current contractor's certificate signed by manufacturer declaring Contractor as an approved installer of polishing system.
 - 3. Manufacturer's Instructions: Manufacturer's installation instructions.
- E. Warranty: Submit warranty documents specified.
- F. Operation and Maintenance Data: Submit operation and maintenance data for installed products.
 - 1. Manufacturer's instructions on maintenance renewal of applied treatments.
 - 2. Protocols and product specifications for joint filing, crack repair and/or surface repair.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer with a minimum of 5 years' experience in performing work of this section who has specialized in installation of work similar to that required for this project.
 - 2. Installer trained and holding a current certificate as a FGS PermaShine installer.
 - 3. Current Certification from the CPAA stating that the technicians are trained craftsmen.
- B. Concrete finishing components and materials shall be from single manufacturer.
- C. Manufacturer Qualifications:
 - 1. Manufacturer capable of providing field service representation during construction and approving application method.
 - 2. Manufacturer shall have a minimum 5 years of experience in manufacturing components similar to or exceeding requirements of project.
- D. Regulatory Requirements: Comply with NFSI Test Method 101-A Phase Two Level High Traction Material.
- E. Mock-Ups:

- 1. Mock-Up Size: 10' x 10' sample panel at jobsite at location as directed under conditions similar to those which will exist during actual placement.
- 2. Mock-up will be used to judge workmanship, concrete substrate preparation, operation of equipment, material application, color selection and shine.
- 3. Allow 96 hours for inspection of mock-up and Owner approval, before proceeding with work.
- 4. If accepted, mock-up will demonstrate minimum standard of quality required for this work.
 - A. Approved mock-up may remain as part of finished work.
- 5. Mock-Up will demonstrate required level of cut:
 - A. Level 2 Salt/Pepper Finish: Expose the fine aggregate such as sand and small aggregate with the concrete. The depth of grind will depend greatly on the placement and finishing procedures. Generally, this level of cut can be achieved within 1/16" of the surface.
 - B. Sheen Level B: Sheen (high gloss) as determined by a gloss reading of 60 70. Gloss readings are not to be obtained through the use of any topical protective coating enhancers or the result of resin transfer from resin bond abrasives. Take readings before application of these products. <u>The specified gloss reading shall be determined using a</u> <u>gloss meter.</u>
- F. Pre-installation Meetings: Conduct a pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements. Review the following:
 - 1. Environmental requirements.
 - 2. Scheduling and phasing of work.
 - 3. Coordinating with other work and personnel. Remind all trades that they are working on a surface that is to become a finished surface.
 - 4. Protection of adjacent surfaces.
 - 5. Surface preparation.
 - 6. Repair of defects and defective work prior to installation.
 - 7. Cleaning.
 - 8. Installation of polished floor finishes.
 - 9. Application of liquid hardener, densifier.
 - 10. Protection of finished surfaces after installation.
 - 11. placing of materials on the concrete surface that may cause staining, etching or scratching

1.8 DELIVERY, STORAGE AND HANDLING

- A. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- B. Delivery: Deliver materials in manufacturer's original packaging with identification labels and seals intact.
- C. Storage and Protection: Store materials protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.

1.9 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.
- B. Protect Concrete Slab:
 - 1. Protect from petroleum stains during construction.
 - 2. Diaper hydraulic power equipment.
 - 3. Restrict vehicular parking.
 - 4. Restrict use of pipe cutting machinery.

- 5. Restrict placement of reinforcing steel on slab.
- 6. Restrict use of acids or acidic detergents on slab.

C. Waste Management and Disposal:

- 1. Separate waste materials for Reuse and Recycling in accordance with Section 01 74 19 -Construction Waste Management and Disposal.
- 2. Remove from site and dispose of packaging materials at appropriate recycling facilities.

1.10 PROJECT AMBIENT CONDITIONS

A. Installation Location: Comply with manufacturer's written recommendations.

1.11 SEQUENCING

A. Sequence with Other Work: Comply with manufacturer's written recommendations for sequencing construction operations.

1.12 WARRANTY

A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and does not limit, other rights Owner may have under Contract Documents.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: 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
- B. Requests for substitutions will be considered in strict accordance with provisions of Section 01 25 00 Substitution Procedures.

2.2 POLISHED CONCRETE

- A. Products/Systems:
 - 1. Hardener, Sealer, Densifier: Proprietary, water based, odorless liquid, VOC compliant, environmentally safe chemical hardening solution leaving no surface film.
 - A. Acceptable Material: L & M Construction Chemicals, Inc., FGS Hardener Plus. Basis of design.
 - B. Acceptable Material: L&M Construction Chemicals, Inc., Lion Hard may be substituted when conditions exist where disposing of rinse water is in conflict with local building codes.
 - 2. Joint Filler: Semi-rigid, 2-component, self-leveling, 100% solids, rapid curing, polyurea control joint and crack filler with Shore A 80 or higher hardness.
 - A. Acceptable Material: L & M Construction Chemicals, Inc., Joint Tite 750.
 - 3. Oil Repellent Sealer: Ready to use, silane, siloxane and fluoropolymers blended water based solution sealer, quick drying, low-odor, oil and water repellent, VOC compliant and compatible with chemically hardened floors.
 - A. Acceptable Material: L & M Construction Chemicals, Inc., Petrotex.
 - 4. Concrete Dyes: Fast-drying dye, packaged in premeasured units ready for mixing with water or VOC exempt solvent; formulated for application to polished cementitious surfaces.
 - A. Acceptable Material: L & M Construction Chemicals, Inc., Vivid Concrete Dyes or Vivid Dye WB Plus.

POLISHED CONCRETE FINISHING

- B. Color: As Selected by Architect.
- 5. Cleaning Solution: Proprietary, mild, highly concentrated liquid concrete cleaner and conditioner containing wetting and emulsifying agents; biodegradable, environmentally safe and certified High Traction by National Floor Safety Institute (NFSI).
 - A. Acceptable Material: L & M Construction Chemicals, Inc., FGS Concrete Conditioner.
- 6. Stain Guard Sealer: Ready to use, is a low odor, VOC compliant, topical sealer consisting of low molecular emulsified cross-linking, coupling polymers that effectively protect concrete and other natural stone floor surfaces from the damaging effects of staining, defacing and deterioration due to contaminant penetration.
 - A. Acceptable Material: L& M Construction Chemicals, Inc. Permaguard SPS.
- 7. Finish: Medium gloss (MG-2), 800 with a minimum of seven (7) abrasives passes.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Site Verification of Conditions:
 - 1. Verify that concrete substrate conditions, which have been previously installed under other sections or contracts, are acceptable for product installation in accordance with manufacturer's instructions prior to installation of concrete finishing materials.
- 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.

3.2 PREPARATION

- A. Ensure surfaces are clean and free of dirt and other foreign matter harmful to performance of concrete finishing materials.
- B. Examine surface to determine soundness of concrete for polishing.

3.3 INSTALLATION

- A. Compliance: Comply with manufacturer's written data, including product technical bulletins, product catalog installation instructions, product carton installation instructions.
- B. Floor Surface Polishing and Treatment:
 - 1. Provide polished concrete floor treatment in entirety of slab indicated by drawings. Provide consistent finish in all contiguous areas.
 - 2. Apply floor finish prior to installation of fixtures and accessories.
 - 3. Diamond polish concrete floor surfaces with power disc machine recommended by floor finish manufacturer. Sequence with coarse to fine grit. Installer to determine the optimum starting grit in order to achieve the specified aggregate exposure.
 - A. Comply with manufacturer's recommended polishing grits for each sequence to achieve desired finish level. Following the initial passes of metal bond diamonds, the installer shall drop back a minimum of one grit level when transitioning to resin bond diamonds. The separation in grit designation shall be a minimum of 50 for the transitioning step. The installer shall refine each abrasive grit to its fullest potential before moving on to the next level. Floor shall be thoroughly scrubbed between each grit pass to remove all loose material. Level of sheen shall match that of approved mock-up.
 - B. Expose aggregate in concrete surface only as determined by approved mock-up.
 - C. All concrete surfaces shall be as uniform in appearance as possible.

- 4. Dyed and Polished Concrete:
 - A. Locate demarcation line between dyed surfaces and other finishes.
 - B. Polish concrete to the 400 grit level, (200 grit for water based dyes).
 - C. Apply pre-mixed dyes to polished concrete surface.
 - D. Allow dye to dry.
 - E. Remove residue with water and buffer pad; reapply as necessary for desired result.
- 5. Hardener and Densifier Application:
 - A. First coat of FGS Hardener Plus at 250 ft2/gal (6.25 m2/L), following the 400 grit level. (Lion Hard at 400-600 sq ft / gallon).
 - B. Second coat of FGS Hardener Plus at 350 ft2/gal (8.75 m2/L), prior to the final polishing pass (Lion Hard at 600-800 sq ft / gallon).
 - C. Follow manufacturer's recommendations for drying time between successive coats.
- 6. Remove defects and re-polish defective areas.
- 7. Finish edges of floor finish adjoining other materials in a clean and sharp manner.

3.4 ADJUSTMENTS

- A. Re-polish those areas not meeting specified gloss levels per mock-up.
- B. Fill joints flush to surface prior to the start of polishing operations.

3.5 FINAL CLEANING

A. Upon completion, remove surplus and excess materials, rubbish, tools and equipment.

3.6 **PROTECTION**

A. Protect installed product from damage during construction in accordance with manufacturer's recommendations.

SECTION 04 05 13 — MORTAR

PART 1 - GENERAL

1.01 COORDINATION

- A. The General Conditions of the Contractor for Construction and the Supplementary Conditions to the General Conditions of the Contract for the Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addendum issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the stringent requirements and the greater quantity shall apply.
- 1.02 SCOPE:
 - A. Perform all work required to furnish the Masonry Mortar indicated by the Contract Documents and furnish all supplementary items necessary for its proper installation.
 - B. The requirements of Division 0 "Bidding and Contract Requirements" and Division 1 "General Requirements" of this Project Manual shall apply to all Work required for this Section.
- 1.03 SUBMITTALS:
 - A. Submit product data on all mortar and admixtures.
 - B. Submit certification that mortar and grout material meet ASTM standards.

1.04 PRODUCT DELIVERY AND STORAGE:

- A. Delivery: Delivery materials to Project site dry and in unbroken containers.
- B. Storage: Store materials above ground in waterproof shelters.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. Material manufactured by any of the following manufacturers is acceptable, provided it complies with the Contract Documents.
 - 1. PORTLAND CEMENT:
 - a. Capitol Lone Star
 - b. Trinity Texas Industries
 - c. Universal Atlas Cement
 - 2. LIME:

- a. Gibsonburg Lime Products Co., Tiger Limes
- b. Texas Lime Company
- c. United States Gypsum Company
- d. National Gypsum Company

3. WATER PROOFING ADMIXTURE:

- a. Blocktite Mortar Admixture by Euclid Chemical
- b. Sonneborn Building Products-Hydracide
- c. W.R. Grace-Hydratite Plus
- 4. MORTAR COLOR:
 - a. Match Existing
- 5. DRY BLOCK-One pound per cubic foot of cementitious material, ½ sack per sack of 2 sacks of cement fluted, split –face CMU for warranty purposes
- B. Refer to Section 01 25 00 Substitutions Procedures for manufacturers not listed above.

2.02 MATERIALS:

Portland Cement: ASTM C150, TYPE I. A. B. Hydrated Lime: ASTM C207, TYPE S. C. Fine Aggregate: ASTM C144, D. Coarse Aggregate: ASTM C404, Size No. 8 E. Water: Clean and free of deleterious acids, alkalies, or organic matter. Blocktite Mortar Admixture, manufactured by Euclid Chemical Co. F. Waterproofing Admixture: G. "EUCON Blocktite" by the Euclid Chemical Co. Masonry Admixture:

2.03 PROPORTIONS AND MIXING:

- A. Meet requirements of ASTM C270 and proportion mortar types as specified.
- B. Meet requirements of ASTM C476 for masonry grout and proportion grout type as specified.
- C. Proportion material accurately and mix thoroughly by machine to a uniform consistency and color. Mix mortars with the maximum amount of water consistent with workability. <u>Provide waterproofing mortar admixture as specified above.</u>
- D. Do not use mortar that has begun to set. Retemper mortar by adding water if mortar begins to stiffen from evaporation or absorption of a part of the mixing water. Use and place mortar in final position within 2-1/2 hours after mixing.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. See specific section of Masonry Materials for installation instructions.

3.02 MORTAR SCHEDULE:

- A. Exterior Masonry Walls:
 - 1. Mortar-Type S, ASTM C270.
 - 2. Waterproofing Admixture-*dry block required to provide warranty.*
- B. Interior Masonry Partitions:1. Mortar-Type N, ASTM C270.
- C. Interior Paving Tile:1. Mortar-Type S, ASTM C270.
- D. Exterior Paving Tile:1. Mortar-Type M, ASTM C270.

3.03 GROUT SCHEDULE:

- A. Paving Tile:
 - 1. Portland Cement-one part.
 - 2. Fine Aggregate-three parts.
 - 3. No lime.
 - 4. Sealer

SECTION 04 21 13 — BRICK MASONRY

PART 1 - GENERAL

1.1 COORDINATION:

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 SUBMITTALS:

- A. Within fifteen (15) calendar days after awarded of contract submit the following:
 - (1) Submit technical data for each type of masonry wall reinforcement, anchors, and ties.
 - (2) Submit sample panel of brick specified showing full color range.

1.3 MOCKUP:

- A. Lay up, where directed at Site, mock-up panel 4 feet high by 6 feet wide using range of brick selected for facing and mortar specified.
- B. **Do not proceed** with brickwork on Project until sample panel has been approved for color and shading. Approved panel shall be the standard of comparison for workmanship and materials. Do not destroy, alter, or move panel until brickwork is completed.

1.4 STORAGE AND HANDLING:

- A. Handle materials in manner to prevent breakage and chipping.
- B. Store materials on platforms raised free of the ground and protect materials with tarpaulin covers.
- 1.5 EVIROMENTAL CONDITIONS:
 - A. Do not lay brick when the temperature of the outside air is 40°F or less, or will fall below 40°F twenty four (24) hours after laying.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Material manufactured by any of the following manufacturers is acceptable provided it complies with the Contract Documents.

REINFORCEMENT, ANCHORS AND TIES:

- 1. AA Wire Products Company
- 2. Heckmann Building Products, Inc.
- 3. Hohmann and Barnard, Inc.
- 4. Masonry Reinforcing Corp. of America
- 5. National Wire Products Corp.

2.2 MATERIALS

- A. MANUFACTURERS (Match Existing):
 - 1. Hanson Brick Co.
 - 2. Acme Brick Co.
 - 3. Brick Selections
- B. Type: Comply with ASTM C-216, Grade SW, Type FBS for face brick. Comply with ASTM C902-87 for brick pavers. Provide letter for compliance from brick manufacturer or supplier.
- C. Shapes: Provide any special molded shapes required or as may be indicated in the drawings. All outside face brick corners other than 90° shall require shaped brick. All outside corners for soldier courses shall require shaped brick. Job cutting face brick shall not be acceptable where cut face is exposed. Provide shop drawings for Architect's approval.
- D. Solids: Provide solids as required to ensure against exposed cores or unfinished face on ends.
- E. Size: Modular (2-1/4" x 7-5/8" x 3-5/8") and as indicated in the drawings. (Match Existing)
- F. Selections:
- Brick Color, Field Color: Colors to match existing.
- G. CORRUGATED METAL TIES: DUR-O-WAL D/A 518 adjustable wall tie. Tie number as recommended by manufacturer for overall wall thickness. Zinc coating – 1.50 oz. per sq. ft. of uncoated wire surface – ASTM A 153- Class B-2.
- H. CLEANING AGENT: TRISODIUM PHOSPHATE (Calgon) and household detergent.
- I. WATER: Clean and free of deleterious acids, alkalies, or organic materials.
- J. CONTROL JOINT SPACER: As specified in the CONCRETE MASONRY Section.
- K. PREMOLDED NEOPRENE PAD: ASTM D 1056SCE-43, R431-N by RUBTEX CORP., 3" wide, by 1/8" thick.
- L. WEEPS: Plastics tubes, 3/8" diameter, AA Wire Products Co., AA223.

- M. REINFORCING BARS: ASTM A615, Grade 60 deformation per ASTM A305, number 4 bars unless otherwise indicated.
- N. MORTAR SCREENS: #84 Weep thru mortar deflector by Heckmann Building Products.

PART 3 - EXECUTION

3.1 PREPARATION:

- A. Provide, install and maintain all scaffolding, staging and forms of protection necessary for execution of the work; substantially constructed, maintained, moved and dismantled as required to properly follow the sequence of the operation.
- B. Provide and install all shores and centering for the work, constructed true to required shape, size and form, well braced and made rigid in all parts, and capable of supporting and sustaining the loads to which subjected.
- C. Leave all shores and centering in place until the masonry has sufficiently set to safety carry its own weight and added loads of construction. Shore all free standing wall until protected from damage by windstorm.
- D. Examine surfaces to receive masonry and report and discrepancies before commencing work. Accept no former measurements, but layout work according to the plans and figures thereon.

3.2 ADJUSTING

- A. All brick having absorption rates determined in accordance with ASTM C67 in excess of 0.025 oz. per sq. ft. inch per minute shall be wetted sufficiently so that the rate of absorption when laid does not exceed this amount. Wetting shall be such as to insure that each unit is nearly saturated, surface dry when laid.
- B. Lay brick plumb, level and true to a line running bond or as indicated. Lay 3 courses to 8" vertically with uniform horizontal and vertical joints. Glaze brick and tile shall be laid stack bond
- C. Lay brick in full bed or mortar with head and edge joints completely filled. Spread mortar for bed joint only so far ahead of laying units that the mortar will be plastic when units are laid. Butter end of brick for head joints with ample mortar so the vertical joint is completely filled with mortar when brick is shoved into place.
- D. Rock closures into place with both head joints and closure space spread with ample mortar. Shove against the two adjacent bricks in place so that both horizontal and vertical joints are completely filled. Do not disturb previously laid brick.
- E. Avoid over-plumbing and pounding of the corner and jambs to fit stretcher units after setting in place. Where adjustments must be made after initial setting, remove mortar and replace with fresh mortar.
- F. Fill the vertical, longitudinal joint between brick and backup as the course is laid, by pouring or slushing the vertical joint full or grout with the same mortar as used for setting.
- G. Keep cavity clear by laving a board, ³/₄" x cavity width, across a level of the ties to catch the droppings. As masonry reaches the next level for placing ties, raise the board, clean it and lay it on ties at that level.

- H. Finish joints that will remain exposed with a tool slightly larger that he width of the joint, to form a concave surface. Tool joints after the mortar has taken its initial set and in such manner as to squeeze the mortar back into the joint. Tool vertical joint first.
- I. Fill all nail or line-pipe holes with fresh mortar immediately upon removal. Provide weeps in head joints 16" on centers, in first horizontal course above flashings. Keep cavity side of weep free from mortar or accumulated materials.
- J. Cut brick, where necessary for fitting or bonding, with a power saw to insure straight, evenly cuts edges.
- K. Cover tops of walls at end of day's work and when rain or is imminent with waterproof membrane. Overhang two feet on each side of wall and anchor securely. Protect masonry from weather or construction damage.
- L. Stop off longitudinal run of masonry where absolutely necessary by racking one-half length in each course. Remove loose mortar before new work is started and slightly wet old work.

3.2 ANCHORING:

- A. Space anchors not over 16" on center vertically and 24" on centers horizontally. Locate anchors at vertical and horizontal supports, and at other locations as indicated.
- B. Bond brick to backup with adjustable wall ties and joint reinforcing installed in adjacent masonry.
- C. Maintain a minimum of ¹/₂" clearance between masonry and concrete or steel structure. Keep space free of mortar and other rigid material.

3.3 CONTROL AND EXPANSION JOINTS:

- A. Locate expansion joints where they occur in backup material. Locate control joints no to exceed 25'-0" on center. Keep vertical joints straight, true and continuous from top to bottom of masonry. Verify locations of control joints with Architect.
- B. Keep joints clean of mortar as work progresses. Build-in control joint spacer at control joints and flashings at expansion joints

3.4 EMBEDDED ITEMS:

A. Build in flashings, sleeves, anchors, clips and accessories as work progresses. Install loose lintels, as indicated, in full beds of mortar.

3.5 CLEANING:

- A. Keep face of brickwork free excess mortar while laying brick. Brush with dry fiber brush prior to wet cleaning.
- B. Clean brickwork that will remain exposed promptly with fiber brushes, clean water and cleaning agent. Use or wire brushes, commercial cleaner or acid permitted only with specific approval.
- C. Repair and repoint defective work. Replace broken, damaged or discolored brick.

D. Pressure wash all exterior brick work prior to Owner occupying new building.

SECTION 04 22 00 — CONCRETE MASONRY UNIT

PART 1 - GENERAL

1.01 COORDINATION

- A. The General Conditions of the Contractor for Construction and the Supplementary Conditions to the General Conditions of the Contract for the Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addendum issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the stringent requirements and the greater quantity shall apply.

1.02 SCOPE:

- A. Perform all Work required to complete the Concrete Unit Masonry indicated by the Contract Documents and furnish all supplementary items necessary for its proper installation.
- B. The requirements of Division 0 "Bidding and Contract Requirements" and Division 1 "General Requirements" of this Project Manual shall apply to all Work required for this Section.

1.03 PRODUCTS INSTALLED UNDER THIS SECTION BUT SPECIFIED ELSEWHERE:

- A. Section 04 05 13 Mortar.
- B. Section 07 92 00 Sealants and Caulking.

1.04 SUBMITTALS:

- A. Submit technical data for each type wall reinforcement, anchors and ties.
- B. Submit 12" long sample of control joint filler.
- C. Submit certificate that masonry units conform to ASTM and NBFU standards specified.

1.05 STORAGE AND HANDLING:

A. Handle materials in a manner to prevent breakage and chipping. Store materials on platforms raised free of ground and protect materials with stainproof tarpaulin covers.

1.06 ENVIRONMENTAL CONDITIONS:

A. Lay no masonry when the temperature of the air is 40°F. twenty-four (24) hours after laying. Do not build on frozen work.

B. Store masonry units on the job so that they are kept off the ground and protected from rain.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. Material manufactured by any of the following manufacturers is acceptable, provided it complies with the Contract Documents.
 - 1. CONCRETE MASNORY UNIT: Best Block
 - 2. REINFORCEMENT, ANCHORS AND TIES: National Wire Products Corp. AA Win Heckman Build Products, Inc. Hohman Masonry Reinforcing Corp. of America

AA Wire Products Company Hohmann and Barnard, Inc.

3. SPLIT FACE BLOCK SEALER: "DEFY" Split Face Block Water Repellant

2.02 MATERIALS:

- A. UNITS:
 - 1. Hollow Concrete Masonry: ASTM C90, medium weight, Grade N-1
- B. REINFORCEMENT:
 - Block Wall Joint Reinforcement: ASTM A82, AA Wire Products Co., "BLOK-TRUS", AA600 two wire, width 2" less than wall thickness, standard weight galvanized ASTM A116, Class 1.
 - 2. Lintel and Bond Beam Reinforcement: Domestic, ASTM A615, or ASTM A616, deformations ASTM A305. Unless otherwise shown on drawings provide 2-#4 Ø cont. lap 30 dias.
- C. WATER: Clean and free of deleterious acids, alkalies or organic material.

D. <u>Bullnose edge at all masonry corners for interior walls. Provide sealer for all exterior split face</u> <u>c.m.u.</u>

PART 3 - EXECUTION

3.01 CONDITION OF SURFACES:

- A. Do not commence with masonry work until foundation has properly cured a minimum of seven (7) days and reinforcing steel that is dowelled for masonry units has been approved.
- B. Consult other trades and make provisions to permit installation of their work to avoid cutting and patching. Before closing up any pipe chase, or similar inaccessible spaces, remove all rubbish and sweep out areas to be enclosed.
- 3.02 PREPARATION:

- A. Provide, install and maintain all scaffolding, staging and forms of protection necessary for execution of the work; substantially constructed, maintained, moved and dismantled as required to properly follow the sequence of operation.
- B. Provide and install all shores and centering for the work, constructed true to require shape, size and form; well-braced and made rigid in all parts, and capable of supporting and sustaining the loads to which subjected.
- C. Leave all shores and centering in place until the masonry has sufficiently set to safely carry its own weight and the added loads of construction. Shore free-standing walls to prevent windstorm damage until walls are protected.
- D. Examine surfaces to receive masonry and report any discrepancies before commencing work. Accept no former measurements, but lay work according to the plans and dimensions thereon.

3.03 LAYING CONCRETE MASONRY UNITS:

- A. Do not dampen units before laying, and do not lay units which have surface water or contain frost. Lay units plumb, level, and true to a line in running bond, or as indicated. Align on exposed face or as indicated.
- B. Lay first course of masonry in full bed of mortar. Lay all other hollow units in a full mortar bed on shell surface and at ends.
- C. Lay hollow units with the thicker edge of the face shell up and make all joints 3/8" thick. Lay corners prior to laying mid-portion of wall. Rock closures into place with the head joints shoved against the two adjacent units in place.
- D. Cut units with power saw through the unit to insure straight, evenly cut edges. Do not use fractional parts of masonry units in the work where whole units can be used.
- E. Avoid over-plumbing and pounding of the corners and jambs to fit stretcher units after setting in place. Remove mortar and replace with fresh mortar where adjustment must be made after initial settings.
- F. Do not use masonry units having cracks, chipped edges, broken corners or other defects in exposed faces. Build walls full thickness as shown. Blocks with open cells exposed will not be permitted.
- G. Provide all special precast lintels, fillers, closers, control joint units, trough tile, etc., required to form all corners, returns, openings, jambs, offsets, etc., to maintain a proper bond throughout all masonry work.
- H. Protect all sills, ledges, off-sets, etc., from droppings of mortar and protect door jambs and corners from damage during construction.
- I. Stop off longitudinal run of masonry only where absolutely necessary by racking one-half block length in each course. Remove loose mortar before new work is started.
- J. Cover tops of walls at end of day's work and when rain is imminent, with waterproof membrane. Overhang two feet on each side of wall and anchor securely. Protect masonry from weather or construction damage.
- 3.04 JOINTS:

- A. Mortar joints shall be straight, clean and uniform in thickness. Tool joints of all walls to produce a dense surface well bonded to the edges. Joints which are not tight at the time of tooling shall be raked out, pointed, and then tooled.
- B. Tool when the mortar is partially set but still sufficiently plastic to bond. Use a tool which compacts the mortar, pressing the excess mortar out of the joint rather than dragging it out.
- C. Finish joints that will remain exposed with a tool slightly larger than the width of the joint to form a concave surface. Tool vertical joint first. Finish flush, joint that will not remain exposed.
- D. Unless otherwise specified the horizontal and vertical mortar joints shall be 3/8" thick with full mortar coverage on the face shells and on the webs surrounding cells to be filled with grout.
- E. Vertical head joints shall be buttered well for a thickness equal to the face shell of the unit and these joints shall be shoved tightly so that the mortar bonds with both units. Joints shall be solidly filled from the face of the block to at least the depth of the face shell.

3.05 REINFORCING:

- A. Install continuous joint reinforcing 16" on centers for running bond. Install joint reinforcing in the first and second bed joint above and below openings extending 24" beyond each side of opening.
- B. Lap splices a minimum of 6" and install prefabricated corners and tees at such locations. Do not extend reinforcing through expansion joints. Center reinforcing in joint with 5/8" minimum mortar coverage on the exterior face and ½" minimum mortar coverage on the interior face.
- C. Do not extend reinforcing through control joints when anchorage is provided on each side of joint. If no anchorage is provided at joint, extend reinforcing through control joint at 48" on center.
- D. Reinforce bond beams and lintels as indicated with continuous bars placed as the work progresses. Maintain ¹/₂" minimum clear distance between masonry units and reinforcement.

3.06 ANCHORING:

- A. Anchor interior partitions to abutting or intersecting walls by common bond or with prefabricated reinforcing tees.
- B. Anchor interior load bearing partitions laterally a maximum of 12'-0" o.c. by either an intersecting partition or anchorage to foundation with $4-\#4\emptyset$ dowels and continuous $4 \#4\emptyset$ bars to top of wall. Grout fill cells to top of wall.
- C. Do not attach construction supports to wall except where specifically permitted by the Architect.
- D. Intersecting load bearing masonry walls and partitions shall be bonded by the use of rigid steel anchors at twenty-four (24) inches o.c. maximum. Corners shall have a standard masonry bond by overlapping units and shall be solid grouted.

3.07 CONTROL JOINTS:

- A. Locate 3/8" wide control joints as indicated but do not exceed 30 feet on centers. Keep vertical joints straight, true and continuous from top to bottom of masonry.
- B. Use sash units to form control joints and install continuous control joint filler with sash units tightly butted to compress neoprene flanges and completely seal joint. Where masonry abuts structural concrete

or steel and control joint filler cannot be used, keep joint clean of mortar as work progresses or use expansion joint spacer.

C. Locate building expansion joints as indicated and install expansion joint spacer properly recessed back from face to allow for sealant.

3.08 EMBEDDED ITEMS:

- A. Build in flashing, sleeves, anchors, clips, mechanical and electrical items, and accessories as work progresses. Accurately cut units to fit all plumbing, ducts, openings and electrical work with all holes neatly patched.
- B. Install loose lintels, as indicated in full beds of mortar. Fill voids at metal frames with mortar and build in frame anchors.

3.09 GROUTING:

- A. Fill with grout, vertical cells, bond beams, lintels and other structural members having reinforcement. Secure in place and inspect reinforcing before grouting. Keep mortar droppings out of grout space and puddle or vibrate all grout in place.
- B. Provide solid bearing under structural members at least 8" vertically and at least 16" horizontally. Bearing shall be hollow units reinforced with 2#4Ø bars U.N.O. and filled with concrete grout.
- C. Build masonry in filled cell construction to preserve the unobstructed vertical continuity of the cells to be filled. Fully bed all walls and cross webs forming such cells to prevent leakage of grout and strike cell joints smooth. Maintain a continuous vertical alignment of cells so the unobstructed cell area is not less than 2"x3".
- D. Grout vertical cells in lifts not to exceed 4'-0". Stop grout where necessary at mid-point but not over openings, when filling trough unit and provide suitable dam to retain grout. Stop grout one and one half inches below the top of the last course when filling vertical cells to form key for next pour.
- E. Grout from inside face of masonry and prevent grout from staining masonry face. Protect projecting surfaces from droppings and clean immediately any grout which comes in contact with face of masonry.

3.010 CLEANING:

- A. Keep face of blockwork free from excess mortar while laying blocks. Clean blockwork that will remain exposed, promptly, with fiber brushes and clear water. Use of wire brushes or acid permitted only with specific approval.
- B. Repair and repoint defective work and pin line holes to match adjacent similar work. Replace broken or damaged blocks.

SECTION 05 41 00 — LIGHT GAGE METAL FRAMING SYSTEMS AND GYPSUM SHEATHING

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 WORK INCLUDED

- A. Furnish and install exterior/interior metal stud framing as shown on the drawings and specified herein.
- B. Furnish and install water resistant gypsum board sheathing at exterior face of exterior metal studs.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Masonry.
- B. Interior drywall systems.
- C. Wall Insulation.
- D. Dampproofing and Waterproofing.
- E. Exterior plaster (stucco).

1.4 SUBMITTALS

- A. Submit manufacturer's product data describing all materials.
- B. Submit manufacturer's certification of structural properties, only for products to be used in the project.

1.5 WARRANTY

A. Provide written warranty against defects in materials and workmanship for the work under this section for a period of one year after the date of Substantial Completion of the project.

1.6 DELIVERY, STORAGE AND HANDLING

- A. All materials shall be delivered in manufacturer's original packaging and stored flat in a covered, dry area providing protection from damage and exposure to the elements.
- B. Damaged or deteriorated materials shall be removed from the premises.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. STUDS AND FRAMING: Unimast, Clark Dietrich, Maverick Steel Co., Dale Industries, Delta Metals, Bostwick, American Studco Inc.
- B. GYPSUM BOARD SHEATHING: United States Gypsum Co., National Gypsum Co., Domtar Gypsum, Inc. Georgia Pacific, Temple Inland.

2.2 MATERIALS

A. STRUCTURAL STUDS AND RUNNERS: Galvanized "Cee" studs in sizes and gauges as indicated in the drawings. Unless otherwise indicated in the drawings, minimum gauge shall be 16 gauge and the following structural properties shall apply:

ABOUT MAJOR AXIS X-X			ABOUT MINOR AXIS Y-Y		
lx	Sx	rx	ly	Sy	ry
.906	.500	1.430	.139	.142	.614
1.145	.572	1.566	.147	.143	.615
3.016	1.005	2.262	.180	.149	.595
6.071	1 518	2 923	201	152	565
	ABOU 1x .906 1.145 3.016 6.071	ABOUT MAJOR AX lx Sx .906 .500 1.145 .572 3.016 1.005 6.071 1.518	ABOUT MAJOR AXIS X-X lx Sx rx .906 .500 1.430 1.145 .572 1.566 3.016 1.005 2.262 6.071 1.518 2.923	ABOUT MAJOR AXIS X-X ABOU Ix Sx rx Iy .906 .500 1.430 .139 1.145 .572 1.566 .147 3.016 1.005 2.262 .180 6.071 1.518 2.923 .201	ABOUT MAJOR AXIS X-X ABOUT MINOR AX Ix Sx rx Iy Sy .906 .500 1.430 .139 .142 1.145 .572 1.566 .147 .143 3.016 1.005 2.262 .180 .149 6.071 1.518 2.923 .201 .152

- B. SHEATHING FASTENERS: Unimast self-drilling screw fasteners (bugle head).
- C. SHEATHING: Fire resistant gypsum board with treated water resistant gypsum core surfaced with water repellant paper both faces -1/2" x 4' x 8' with tongue and groove joint design at long edges. Meet requirements of ASTM C-79. Provide 5/8" thick rated X core where specifically indicated on the drawings.
- D. All metal studs, track, and bridging shall be formed from ASTM A-446 commercial grade steel having a minimum yield of 33,000 psi for 18 gauge and lighter members and 50,000 psi for 16 gauge and heavier members.
- E. All framing components shall be galvanized. Tracks, runners, bridging and bracing shall match grade and gauge of studs.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install studs plumb and in plane, without twist. System installation shall be in accordance with AISI Design Manual for "Light Gauge Cold Formed Steel".
- B. All framing components shall be cut tight against abutting members. Members shall be held firmly in position until properly fastened.
- C. All attachments of axial loaded framing components shall be welded in accordance with the American Welding Society's "Recommended Practices for Resistance Welding" and shall transfer the imposed load into the adjoining member. Use no splices in axial loaded members.
- D. Attachments of framing components not subject to axial loads may be welded or screw fastened.
- E. Members shall be braced as required to resist all wind loads and construction loading for which the system has been designed. System shall be braced as erected and shall not be left overnight without adequate bracing.
- F. Framing components used to frame openings shall be of a size and type to transfer any load imposed on the opening into the members adjacent to the opening. Additional framing shall be provided adjacent to the opening to carry the load imposed.
- G. Welds in galvanized material shall be coated with "ZRC" cold galvanizing after wire brushing.

3.2 ERECTION

- A. TRACK FASTENING: Secure metal floor track to concrete floor slab with Type "A" or "B" fasteners spaced as scheduled in the table below. For determining unbraced wall height, ceiling does not qualify as bracing.
 - 1. Type "A" fastener minimum 5/32" diameter x 1-1/4" long powder actuated fasteners. Hilti #DS32P10 or Ramset #2335.
 - 2. Type "B" fastener minimum 1/4" diameter x 2" long drilled sleeve anchor. Hilti sleeve anchor or Ramset "Thunder Nail".
 - 3. Demonstrate to the Architect that fasteners can be driven full length into concrete slab tight to stud track.
 - 4. Use similar fasteners (and spacing) suitable for steel at overhead track or weld track to overhead steel at 12" o.c.
 - 5. At track splices use anchored channel inserts or fully weld.

MAX. SPACING OF	*MAX. UNBRACED WALL HEIGHT		
FASTENERS	TYPE A	TYPE B	
24"	7.4 FT.	8.3 FT.	
16"	11.1 FT.	12.4 FT.	
12"	14.8 FT.	16.5 FT.	
8"	24.9 FT.	24.9 FT.	
6"	29.7 FT.	33.2 FT.	

Spacing Schedule for Type A & B Fasteners

*NOTE: Ceiling at wall does not reduce unbraced wall height.

- B. STUD FASTENING: Each stud shall be fastened to top and bottom track (prior to gypsum board sheathing or interior wall finish) using one of the following two methods:
 - 1. Screw fastening: One self-drilling screw at the front and back faces of the top and bottom tracks for each stud (4 fasteners per stud.)
 - 2. Welding: One weld at the front face of the top and bottom tracks for each stud (2 welds per stud).
 - 3. Additional: The above minimum fasteners are required regardless of any additional bracing or intermediate fastening which may be indicated in the drawings or required.
- C. BRIDGING: Provide bridging at all exterior stud walls whether or not indicated in the drawings. Unless more stringent requirements are indicated in the drawings provide the following:
 - 1. Wind loading resistance only: Provide multiple bridging rows spaced 5'-0" o.c. vertically maximum.
 - 2. Axial loaded members: For stud lengths less than 10 feet, provide 2 rows of bridging at third points. For stud lengths 10 feet and grater, provide multiple bridging rows spaced 42" o.c. vertically maximum.
- D. SHEATHING INSTALLATION: Apply sheathing panels horizontally with the "v" edge turned up. Install with joints and penetrations tight and neatly fit. Stagger end joints over studs with screws spaced at maximum 12" centers at each stud and at 12" o.c. along top and bottom runners.

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 WORK INCLUDED

- A. Provide and install all rough carpentry, formwork, wood framing, blocking, wood furring, hardboard and related fasteners as indicated in the drawings or as required to complete the indicated construction.
- B. Install all related hardware and fasteners. Provide and install wood furring and/or trim for acoustical panels.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Cast-in place concrete
- B. Painting
- C. Finish hardware

1.4 SECTION REQUIREMENTS

- A. Submittals manufacturer's printed literature describing wood preservatives treatment system and certifying that system meets all current requirements for applicable Federal, State and local governing agencies.
- B. Submittals manufacturer's printed literature describing fire retardant treatment system, any structural or usage limitations, and certifying that system meets all current requirements for applicable Federal, State and local governing agencies.

1.5 WARRANTY

A. Provide written warranty against defects in materials and workmanship for the work under this section for a period of one year after the date of Substantial Completion of the project.

1.6 DELIVERY AND STORAGE

A. Deliver and store lumber, plywood and hardwood on sills and cover for protection.

1.7 QUALITY ASSURANCE

- A. All lumber and plywood shall be grade marked by Southern Pine Inspection Bureau, West Coast Lumber Inspection Bureau, American Plywood Association, or Western Wood Products Association.
- B. All lumber and plywood shall be marked with producing manufacturer's trademark.
- C. Certificate of inspection issued by grading association for bundled lumber and plywood may substitute for individual piece marking.

PART 2 - PRODUCTS

2.1 LUMBER, GENERAL

A. Dressed lumber, S4S, 15 percent maximum moisture content for 2-inch (38-mm) thickness or less, marked with grade stamp of inspection agency.

2.2 TREATED MATERIALS

- A. Preservative-Treated Materials: AWPA C2 lumber and AWPA C9 plywood, labeled by an inspection agency approved by ALSC's Board of Review. After treatment, kiln-dry lumber and plywood to 19 and 15 percent moisture content, respectively. Treat indicated items and the following:
 - 1. Wood members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Concealed members in contact with masonry or concrete.
 - 3. Wood framing members less than 18 inches (460 mm) above grade.
 - 4. Wood floor plates installed over concrete slabs directly in contact with earth.
- B. Fire-Retardant-Treated Materials: AWPA C20 lumber and AWPA C27 plywood, interior Type A treatment, labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Use treated lumber and plywood with bending strength, stiffness, and fastener-holding capacities that are not reduced below values published by manufacturer of chemical formulation under elevated temperature and humidity conditions.

2.3 LUMBER

A. Miscellaneous Lumber: No. 3 or Standard grade of any species for nailers, blocking, and similar members as indicated on drawings.

2.4 MISCELLANEOUS PRODUCTS

A. Fasteners: Size and type indicated. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with a hot-dip zinc coating per ASTM A 153 or of Type 304 stainless steel.

- 1. Power-Driven Fasteners: CABO NER-272.
- 2. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.
- B. Metal Framing Anchors: Hot-dip galvanized steel of structural capacity, type, and size indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. COORDINATION: Coordinate work with other trades and provide cutting and patching required to accommodate the work. Verify all dimensions by taking field measurements to ensure proper fit. Accurately cut framing and blocking, and fit true to line and level, avoiding shims and wedges.
- B. Fit rough carpentry to other construction; scribe and cope for accurate fit. Correlate location of furring, blocking, and similar supports to allow attachment of other construction.
- C. ANCHORING AND FASTENTING: Use largest practicable fasteners for each type of work. Bolt nailers and blocking to steel, masonry or concrete members using bolts of proportionate strength to members attached. Unless otherwise noted in the drawings use ³/₄" diameter bolts at maximum 4'-0" centers. Use concealed fasteners in finish work, set nails and use flathead countersunk screws.
- D. WOOD BLOCKING: Install fire-retardant tread wood blocking between metal studs where wallsupported drinking fountains, casework, railings, and other equipment is attached. Install between studs for toilet partitions systems and toilet accessories where anchored to wall. Use minimum 2 x 4 dimension where not indicated otherwise in the drawings.

SECTION 06 16 43 - GYPSUM SHEATHING

PART 1 GENERAL

1.00 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.01 SUMMARY

- A. Section Includes: Fiberglass-mat faced, moisture and mold resistant gypsum sheathing.
- B. Related Sections:
 - 1. Section 05 41 00 Structural Metal Stud Framing.
 - 2. Section 06 10 00 Rough Carpentry.
 - 3. Section 09 21 16 Gypsum Board Assemblies.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM C473 Standard Test Methods for Physical Testing of Gypsum Panel Products.
 - 2. ASTM C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - 3. ASTM C1002 Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
 - 4. ASTM C1177 Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
 - 5. ASTM C1280 Standard Specification for Application of Gypsum Sheathing.
 - 6. ASTM D3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
 - 7. ASTM D6329 Standard Guide for Developing Methodology for Evaluating the Ability of Indoor Materials to Support Microbial Growth Using Static Environmental Chambers.
 - 8. ASTM E72 Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.
 - 9. ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials.
 - 10. ASTM C1396 Standard Specification for Gypsum Board
- B. Gypsum Association (GA): GA-253 Application of Gypsum Sheathing.

1.03 SUBMITTALS

A. Product Data: Manufacturer's specifications and installation instructions for each product specified.

GYPSUM SHEATHING

8/9/2024

1.04 WARRANTY

- A. Provide products that offer twelve months of coverage against in-place exposure damage (delamination, deterioration and decay) commencing with the date of installation of the product in such structure.
- B. Manufacturer's Warranty:
 - 1. Five years against manufacturing defects from the date of purchase of the product for installation
 - 2. 12 years against manufacturing defects when used as a substrate in architecturally specified EIFS.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Georgia-Pacific Gypsum LLC:
 - 1. Fiberglass-Mat Faced Gypsum Sheathing: DensGlass Sheathing.
 - 2. Fiberglass-Mat Faced Gypsum Sheathing, Type X for Fire Rated Designs: DensGlass Fireguard Sheathing.
- B. Size:
 - 1. Thickness: 5/8 inch.
 - 2. Width: 4 feet.
 - 3. Length: 8 feet.
 - 4. R-Value: (ASTM C518) 0.67
- C. Substitutions will be in accordance with Section 01 25 00.

2.02 ACCESSORIES

A. Screws: ASTM C1002, corrosion resistant treated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions:
 - 1. Inspection: Verify that project conditions and substrates are acceptable, to the installer, to begin installation of work of this section.

3.02 INSTALLATION

- A. General: In accordance with GA-253, ASTM C1280 and the manufacturer's recommendations.
 - 1. Manufacturer's Recommendations:
 - a. Current "Product Catalog", Georgia-Pacific Gypsum.

3.03 PROTECTION

A. Protect gypsum board installations from damage and deterioration until date of Substantial Completion.

END OF SECTION

GYPSUM SHEATHING

SECTION 06 40 23 - INTERIOR ARCHITECTURAL WOODWORK

PART 1- GENERAL

1.0 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Interior standing and running trim and rails.
 - 2. Wood cabinets (casework).
 - 3. Laminate clad cabinets (plastic-covered casework).
 - 4. Cabinet tops (countertops) and plastic-covered chair rails.
 - 5. Flush wood paneling.
 - 6. Interior door frames (jambs).
- B. Related Sections: The following sections contain requirements that relate to this section:
 - 1. Division 6 Section 'Rough Carpentry' for furring, blocking, and other carpentry work that is not exposed to view.
 - 2. Division 6 Section 'Finish Carpentry" for carpentry exposed to view that is not specified in this section.
 - 3. Division 6 Section 'Exterior Architectural Woodwork' for exterior woodwork.
 - 4. Division 8 Section "Flush Wood Doors" for doors specified by reference to architectural woodwork standards.
 - 5. Division 9 Section "Painting" for final finishing of installed painted finish architectural woodwork.

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

- B. Product data for each type of product and process specified in this section and incorporated into items of architectural woodwork during fabrication, finishing, and installation.
- C. Fire-retardant treatment data for material impregnated by pressure process to reduce combustibility. Include certification by treating plant that treated materials comply with requirements.
- D. Shop drawings showing location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
- E. Samples for initial selection purposes of the following in form of manufacturer's color charts consisting of actual units or sections of units showing full range of colors, textures, and patterns available for each type of material indicated.
 - 1. Plastic laminate (standard and premium selections).
- F. Samples for verification purposes of the following:
 - 1. Lumber with or for transparent finish, 50 square inches, for each species and cut, finished on one side and one edge.
 - 2. Veneer leaves representative of and selected from flitches to be used for transparent finished woodwork.
 - 3. Wood veneer faced panel products;, with or for transparent finish, 8-1/2 inches by 11 inches, for each species and cut with one half of exposed surface finished, with separate samples of unfaced panel product used for core.
 - 4. Lumber and panel products with factory-applied opaque finish, 8- 1/2 inches by 11 inches for panels and 50 square inches for lumber, for each finish system and color, with one half of exposed surface finished.
 - 5. Laminate clad panel products, 8-1/2 inches, by 11 inches for each type, color, pattern, and surface finish, with separate samples of unfaced panel product used for core.
 - 6. Corner pieces as follows:
 - a. Cabinet front frame joints between stiles and rail as well as exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
 - b. Miter joints for standing trim.
 - 7. Exposed cabinet hardware, one unit of each type and finish.
- G. Product certificates signed by woodwork manufacturer certifying that products comply with specified requirements.
- H. Qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Architects and Owners, and other information specified.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Firm experienced in successfully producing architectural woodwork similar to that indicated for this Project, with sufficient production capacity to produce required units without causing delay in the Work.
- B. Single-Source Responsibility: Arrange for production by a single firm of architectural woodwork with sequence matched wood veneers.
 - 1. Include the veneering of wood doors in the single-firm production, where veneer matching extends across wood doors.

- C. Single-Source Manufacturing and Installation Responsibility: Engage a qualified Manufacturer to assume undivided responsibility for woodwork specified in this section, including fabrication, finishing, and installation.
- D. Installer Qualifications: Arrange for installation of architectural woodwork by a firm that can demonstrate successful experience in installing architectural woodwork items similar in type and quality to those required for this project.
- E. AWI Quality Standard Comply with applicable requirements of "Architectural Woodwork Quality Standards" published by the Architectural Woodwork Institute (AWI) except as otherwise indicated.
- F. Hardware Coordination Distribute copies of approved schedule for cabinet hardware specified in Division 8 Section "Door Hardware" to manufacturer of architectural woodwork; coordinate cabinet shop drawings and fabrication with hardware requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soilage, and deterioration.
- B. Do not deliver woodwork until painting, wet work, grinding, and similar operations that could damage, soil, or deteriorate woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified in 'Project Conditions.'

1.06 PROJECT CONDITIONS

- A. Environments1 Conditions: Obtain and comply with Woodwork Manufacturer's and Installer's coordinated advice for optimum temperature and humidity conditions for woodwork during its storage and installation. Do not install woodwork until these conditions have been attained and stabilized so that woodwork is within plus or minus 1.0 percent of optimum moisture content from date of installation through remainder of construction period.
- B. Field Measurements: Where woodwork is indicated to be fitted to other construction, check actual dimensions of other construction by accurate field measurements before manufacturing woodwork; show recorded measurements on final shop drawings. Coordinate manufacturing schedule with construction progress to avoid delay of Work.
 - 1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with manufacture of woodwork without field measurements. Coordinate other construction to ensure that actual dimensions correspond to guaranteed dimensions.

PART 2- PRODUCTS

2.01 HIGH PRESSURE DECORATIVE LAMINATE MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering high pressure decorative laminates (standard and premium selections) which may be incorporated in the work include:
 - 1. Formica Corp.
 - 2. Nevamar Corp.
 - 3. WilsonArt

2.02 MATERIALS

- A. General: Provide materials that comply with requirements of the AWl woodworking standard for each type of woodwork and quality grade indicated and, where the following products are part of woodwork, with requirements of the referenced product standards, that apply to product characteristics indicated:
 - 1. Hardboard ANSI/AHA A135.4
 - 2. High Pressure Laminate: NEMA LD 3.
 - 3. Medium Density Fiberboard: ANSI A208.2.
 - 4. Particleboard ANSI A208.1
 - 5. Softwood Plywood PS 1.
- B. Formaldehyde Emission Levels: Comply with formaldehyde emission requirements of each voluntary standard referenced below:
 - 1. Particleboard: NPA 8.
 - 2. Medium Density Fiberboard: NPA 9.
 - 3. Hardwood Plywood: HPMA FE.
- C. Fire-Retardant Particleboard: Where indicated, provide panels complying with the following requirements that have fire-retardant chemicals bonded to softwood particles at time of panel manufacture to achieve products identical to those tested for flame spread of 20 or less and for smoke developed of 25 or less per ASTM B 84 by UL or other testing and inspecting organization acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing and inspecting organization.
 - 1. For 45-lb-density panels and thicknesses of 3/4 inch and less, comply with ANSI A208.1 for Grade 1-M-1 except that minimums for modulus of elasticity and screw-holding capacity on face and edge shall be 300,000 psi, 250 lb, and 225 lb, respectively.
 - 2. For 44-lb-density panels and thicknesses of 13/16 inch to 1-1/4 inch, comply with ANSI A208.1 for Grade 1-M-1 except that minimums for modulus of rupture, modulus of elasticity, internal bond, linear expansion, and screw-holding capacity on face and edge shall be 1300 psi, 250,000 psi, 60 psi, 0.50 percent, 250 lb, and 175 lb, respectively.
 - 3. Product: Subject to compliance with requirements, provide "Duraflake FR" by Duraflake Div.; Willamette Industries, Inc.

2.03 FABRICATION, GENERAL

- A. Wood Moisture Content: Comply with requirements of referenced quality standard for moisture content of lumber in relation to relative humidity conditions existing during time of fabrication and in installation areas.
- B. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
 - 1. Corners of cabinets and edges of solid wood (lumber) members less than 1 inch in nominal thickness: 1/16 inch.
 - 2. Edges of rails and similar members more than 1 inch in nominal thickness: 1/8 inch.
- C. Complete fabrication, including assembly, finishing, and hardware application, before shipment to project site to minimum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
D. Factory-cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Smooth edges of cutouts and, where located in countertops and similar exposures, seal edges of cutouts with a water-resistant coating.

2.04 FIRE-RETARDANT-TREATED LUMBER

- A. General: Where indicated, pressure impregnate lumber with fire-retardant chemicals of formulation indicated to produce materials with fire performance characteristics specified.
- B. Fire-Retardant Chemicals: Use chemical formulations specified that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated lumber from untreated lumber.
 - 1. Organic Resin-Based Formulation: Exterior type per AWPA C20 consisting of organic-resin solution, relatively insoluble in water, thermally set in wood by kiln drying.
 - 2. Low-Hygroscopic Formulation: Interior Type A per AWPA C20.
- C. Fire Performance Characteristics: Provide materials identical to those tested for the following fire performance characteristics per ASTM test methods indicated by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify treated lumber with classification marking of inspecting and testing organization in the form of separable paper label or, where required by authorities having jurisdiction, of imprint on lumber surfaces that will be concealed from view after installation.
 - 1. Surface Burning Characteristics: Not exceeding values indicated below, tested per ASTM E 84 for 30 minutes with no evidence of significant combustion.
 - a. Flame Spread: 25.
 - b. Smoke Developed: 50.
- D. Mill lumber after treatment, within limits set for wood removal that does not affect listed fire performance characteristics, using a woodworking plant certified by testing and inspecting organization.
- E. Mill lumber before treatment and implement special procedures during treatment and drying processes that are needed to prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.
- F. Kiln-dry woodwork after treatment to levels required for untreated woodwork. Maintain moisture content required by kiln drying before and after treatment.
- G. Discard treated lumber that does not comply with requirements of referenced woodworking standard. Do not use twisted, warped, bowed, discolored, or otherwise damaged or defective lumber.
- H. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Low-Hygroscopic Formulation (Type A):
 - a. "Flameproof LHC"; Osmose Wood Preserving, Inc.
 - b. "Dricon"; Hickson Corporation.

2.05 STANDING AND RUNNING TRIM AND RAILS FOR TRANSPARENT FINISH

A. Quality Standard: Comply with AWI Section 300.

- B. Backout or groove backs of flat trim members and kerf backs of other wide flat members, except for members with ends exposed in finished work.
- C. Assemble casings in plant except where limitations of access to place of installation require field assembly.
- D. Grade: Premium.
- E. Lumber Species: Birdseye Maple, half round.

2.06 STANDING AND RUNNING TRIM AND RAILS FOR OPAQUE FINISH

- A. Quality Standard: Comply with AWI Section 300.
- B. Grade: Premium.
- C. Backout or groove backs of flat trim members and kerf backs of other wide flat members, except for members with ends exposed in finished work.
- D. Assemble casing in plant except where limitations of access to place of installation require field assembly.
- E. Lumber Species: Any dosed-grain hardwood listed in referenced woodworking standard.

2.07 WOOD CABINETS (CASEWORK) FOR TRANSPARENT FINISH

- A. Quality Standard: Comply with AWI Section 400 and its Division 400A Wood Cabinets."
- B. Grade: Premium.
- C. AWI Type of Cabinet Construction: Flush overlay.
- D. Wood Species for Exposed Surfaces: Maple, rotary cut veneer.
 - 1. Grain Matching: Run and match grain vertically for drawer fronts, doors, and fixed panels.
 - 2. Matching of Veneer Leaves: Slip match.
 - 3. Veneer Matching Within Panel Face: Balance match.
- E. Wood Species for Semiexposed Surfaces: Match species and cut indicated for exposed surfaces.

2.08 LAMINATE CLAD CABINETS (PLASTLC.COVERED CASEWORK)

- A. Quality Standard. Comply with AWI Section 400 and its Division 400B 'Laminate Clad Cabinets."
- B. Grade: Premium.
- C. AWI Type of Cabinet Construction: Flush overlay, unless otherwise indicated.
- D. Laminate Cladding High pressure decorative laminate complying with the following requirements:
 - 1. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - a. Provide selections made by Architect from laminate manufacturer's full range of standard and premium colors and finishes in the following categories:

- (1) Solid colors.
- (2) Patterns.
- 2. Laminate Grade for Exposed Surfaces: Provide laminate cladding complying with the following requirements for type of surface and grade.
 - a. Horizontal Surfaces Other Than Tops: GP-50 (0.050-inch nominal thickness).
 - b. Vertical Surfaces: GP-50 (0.050-inch nominal thickness).
 - c. Edges: GP-50 (0.050-inch nominal thickness).
- 3. Semiexposed Surfaces: Provide surface materials indicated below:
 - a. High pressure laminate, GP-28.

2.09 CABINET HARDWARE AND ACCESSORY MATERIAI.8

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 8 Section 'Door Hardware.'
- B. Cabinet Hardware and Miscellaneous Item Schedule:
 - 1. Adjustable Shelf Standard.
 - a. Manufacturer/Model No.: Knape & Vogt/No. 255.
 - b. Size/Type: 5/8" wide x 3/16" deep, recessed.
 - c. Finish: Bright zinc plate.
 - d. Remarks: 1/2" vertical adjustment.
 - 2. Adjustable Shelf Support:
 - a. Manufacturer/Model No.: Knape & Vogt/No. 256.
 - b. Finish: Bright zinc plate.
 - c. Remarks: For use with No. 255 standard.
 - 3. Slotted Shelf Standard:
 - a. Manufacturer/Model No.: Knape & Vogt/No. 51.
 - b. Size/Type: 3/4" x 3/8" x length shown, surface mount, heavy duty.
 - c. Finish: Bright nickel plate.
 - d. Remarks: 1-5/8" vertical adjustment.
 - 4. Adjustable Shelf Bracket:
 - a. Manufacturer/Model No.: Knape & Vogt/No. 52.
 - b. Size/Type: 112" wide x shelf depth.
 - c. Finish: Bright nickel plate.
 - d. Remarks: For use with No.51 standard.
 - 5. Drawer Slide: (Typical)
 - a. Manufacturer/Model No.: Grant/No. 329.
 - b. Size/Type: Full extension, length to suit drawer.
 - c. Finish: Zinc plate.
 - d. Remarks: 100 lb. rating.
 - 6. Drawer Slide: (To 4-1/2" drawer depth)

- a. Manufacturer/Model No.: Grant/No. 328.
- b. Size/Type: Full extension, length to suit drawer.
- c. Finish: Zinc plate.
- d. Remarks: 50 lb. rating.
- 7. Knobs (at Suites Level):
 - a. Forms + Surfaces Model No. HC430 Series, sizes as selected by Architect from manufacturers standards.
 - b. Finish: Anodized black matte.
- 8. Wire Pulls:
 - a. Manufacturer/Model No.: Stanley/No. 4483112
 - b. Size/Type: 3-1/2" center wire pulls.
 - c. Finish: US 28D.
- 9. Concealed Hinges:
 - a. Manufacturer/Model No.: Stanley/No. 1510.
- 10. Continuous Hinges:
 - a. Manufacturer/Model No.: Stanley/No. STS311-1/4.
 - b. Size/Type: 1-1/2" wide x height of door.
 - c. Finish: US 32.
 - d. Remarks: Provide matching countersunk screws, 2" o.c., both sides.
- 11. Door Catch (Magnetic type)
 - a. Manufacturer/Model No.: Stanley/No. SP4L
 - b. Size/Type: 2" x 1-1/4" case size.
 - c. Finish: Aluminum.
 - d. Remarks: One per leaf to 48", two per leaf to 84".
- 12. Cabinet Lock
 - a. Manufacturer/Modal No.: National/No. C-8053.
 - b. Size/Type: Disc tumbler cam lock.
 - c. Finish: US 26D or US 32D.
 - d. Remarks: Furnish two keys per lock; keyed to Building Standard.
- 13. Sliding Glass Door Locks: K&V 965NP, keyed to building system.
- 14. Track, Upper Guide & Sheaves: Stylmark Model No. 810005 Assembly, 204-Ri clear anodized finish.
- C. Hardware Standard Comply with ANSI/BEMA A156.9 "American National Standard for Cabinet Hardware" for items indicated by reference to BIIMA numbers or referenced to this standard.
- D. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for BHMA code number indicated.
 - 1. Dark Oxidized Satin Bronze, Oil Rubbed, on Bronze Base: BHMA 613 and matching Architect's sample.
 - 2. Satin Chromium Plated, Brass or Bronze Base: BHMA 626.

- 3. Satin Chromium Plated, Steel Base: BHMA 652.
- 4. Satin Stainless Steel, Stainless Steel Base: BHMA 630.
- E. For concealed hardware provide manufacturer's standard finish that complies with product class requirements of ANSJ/BHMA A156.9.
- F. Clear Tempered Float Glass for Shelves: ASTM C 1048, Condition A, style I, type I, quality q3, class 1, seamed at edges before tempering, 1/4-inch thick unless otherwise indicated.

2.10 ARCHITECTURAL CABINET TOPS (COUNTERTOPS) AND CHAIR RAILS:

- A. Quality Standard: Comply with AWI Section 400 and its Division 400C.
- B. Type of Top and Chair Rail: High pressure decorative laminate complying with the following:
 - 1. Grade: Custom.
 - 2. Laminate Cladding for Horizontal Surface: High pressure decorative laminate as follows:
 - a. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - (1) Provide selections made by Architect from manufacturer's full range of standard and premium colors and finishes in the following categories:
 - (a) Solid colors.
 - (b) Patterns.
 - b. Grade: GP-50 (0.050-inch nominal thickness).
 - c. Edge Treatments:
 - (1) Plastic Laminate Edge Treatment: Same as laminate cladding on horizontal surfaces.
 - (2) Wood Edge Treatment: Lumber edge for transparent finish, with matching wood species and cut to be determined.

2.11 FLUSH WOOD PANELING FOR TRANSPARENT FINISH

- A. Quality Standard: Comply with AWI Section 500 and its Division 500A.
- B. Grade: Premium.
- C. Veneer Species: Birdseye Maple half round.
- D. Matching of Adjacent Veneer Leaves: Slip match.
- E. Veneer Matching Within Panel Face: Best match.
- F. Fire Performance Characteristics: Provide paneling composed of panels of wood veneer density and fire-retardant particleboard that are identical in construction to units tested for the following surface burning characteristics per ASTM E 84 by UL or other testing and inspecting organization acceptable to authorities having jurisdiction. Identify panels with appropriate markings of applicable testing and inspecting organization on surfaces that will be concealed from view after installation.
 - 1. Flame Spread: 75 or less.
 - 2. Smoke Developed: 40 or less.

2.12 INTERIOR DOOR FRAMES FOR TRANSPARENT FINISH

- A. Quality Standard: Comply with AWI Section 900B.
- B. Grade: Premium.
- C. Lumber Species: Maple, rotary cut veneer.

2.13 CLOSET AND UTILITY SHELVING:

- A. Quality Standard: Comply with AWI Section 600.
- B. Shelving for Painted Finish (By Section 09 91 00): Comply with the following requirements:
 - 1. Grade: Economy.
 - 2. Shelving Material: Maple faced veneer core plywood.
 - 3. Lumber: Ponderosa Pine or Poplar.

2.14 FASTENERS AND ANCHORS

- A. Screws: Select material, type, size, and finish required for each use. Comply with FS FF-S-111 for applicable requirements.
 - 1. For metal framing supports, provide screws as recommended by metal framing manufacturer.
- B. Nails: Select material, type, size, and finish required for each use. Comply with FS FF-N-105 for applicable requirements.
- C. Anchors: Select material, type, size, and finish required by each substrate for secure anchorage. Provide nonferrous metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts and anchors, as required, to be set into concrete or masonry work for subsequent woodwork anchorage.

2.15 FACTORY FINISHING OF INTERIOR ARCHITECTURAL WOODWORK

- A. Quality Standard: Comply with AWI Section 1500 unless otherwise indicated.
- B. General: The entire finish of interior architectural woodwork is specified in this section, regardless of whether factory applied or applied after installation.
 - 1. Factory Finishing: To the greatest extent possible, finish architectural woodwork at factory. Defer only final touch-up, cleaning, and polishing until after installation. Painted finish by Section 09 91 00 except prime coat.
- C. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces and similar preparations for finishing of architectural woodwork, as applicable to each unit of work.
- D. Transparent Finish for Closed-Grain Woods: Comply with requirements indicated below for grade, finish system, staining, effect, and sheen.
 - 1. Grade: Premium.
 - 2. AWI Finish System #5: Catalyzed polyurethane.
 - 3. Staining for Cherry Only: Match approved sample for color.
 - 4. Effect: Open grain (not filled).
 - 5. Sheen: Dull satin 15-20 deg.

- E. Opaque Finish: Comply with requirements indicated below for grade, finish system, color, effect, and sheen:
 - 1. Grade: Premium.
 - 2. AWI Finish System #11: Catalyzed polyurethane.
 - 3. Color: Match Architect's sample.
 - 4. Sheen: Medium-gloss rubbed effect 35-45 deg.

2.16 MISCELLANEOUS ACCESSORIES

A. Steel Countertop Support Bracket: provide prefinished steel bracket supports at locations as shown on drawings. Brackets shall be by A&M Hardware (888) 647-0200 <u>info@aandmhardware.com</u> Other equal products may be provided if and as specifically approved by Architect by substitution request during bidding period.

PART 3- EXECUTION

3.01 PREPARATION

- A. Condition woodwork to average prevailing humidity conditions in installation areas before installing.
- B. Deliver concrete inserts and similar anchoring devices to be built into substrates well in advance of time substrates are to be built.
- C. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including back priming and removal of packing.

3.02 INSTALLATION

- B. Quality Standard. Install woodwork to comply with AWI Section 1700 for same grade specified in Part 2 of this section for type of woodwork involved.
- C. Install woodwork plumb, level, true, and straight with no distortions. Shim as required with concealed shims. Install to a tolerance of 118 inch in 8'-0" for plumb and level (including tops) and with no variations in flushness of adjoining surfaces.
- D. Scribe and cut woodwork to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.
- E. Fire-Retardant-Treated Wood. Handle, store, and install fire- retardant-treated wood to comply with recommendations of chemical treatment manufacturer including those for adhesives where are used to install woodwork.
- F. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where prefinished matching fastener heads are required, use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork and matching final finish where transparent finish is indicated.
- G. Standing and Running Trim and Rails: Install with minimum number of joints possible, using fulllength pieces (from maximum length of lumber available) to the greatest extent possible. Stagger joints in adjacent and related members. Cope at returns and miter at corners.

- H. Cabinets: Install without distortion so that doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete the installation of hardware and accessory items as indicated. Maintain veneer sequence matching (if any) of cabinets with transparent finish
- I. Tops: Anchor securely to base units and other support systems as indicated.
- J. Paneling: Anchor paneling to supporting substrate with concealed panel-hanger clips and by blind nailing on backup strips, splined-connection strips, and similar associated trim and framing. Do not face nail unless otherwise indicated.
- K. Complete the finishing work specified in this section to whatever extent not completed at shop or before installation of woodwork.
- L. Refer to the Division 9 sections for finishing of painted architectural woodwork.

3.03 ADJUSTMENT AND CLEANING

- A. Repair damaged and defective woodwork where possible to eliminate defects functionally and visually; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semiexposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

3.04 **PROTECTION**

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensures that woodwork is being without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 06 61 16 - SOLID SURFACING

PART 1 – GENERAL

1.0 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.1 SUMMARY

- A. Section Includes:
 - 1. Gibraltar Solid Surface Material.
 - 2. Earthstone Solid Surface Material.
 - 3. Solid Surface Material Shaped Goods (Wilsonart Sinks).
- B. Related Sections:
 - 1. Finish Carpentry: Section 06 10 00.
 - 2. Architectural Woodwork: Section 06 40 23.
 - 3. Sealants: Section 07 92 00.
 - 4. Door Thresholds at Ceramic Tile: Section 09 30 13.
 - 5. Plumbing: Division 22.

1.2 SYSTEM DESCRIPTION

- A. Gibraltar Solid Surface Sheet: Homogenous sheet material composed of acrylic resins, fire-retardant filler materials, and coloring agents.
- B. Earthstone Solid Surface Sheet: Homogenous sheet material composed of acrylic resins, fire-retardant filler materials, and coloring agents.
- C. Solid Surface Shaped Goods (Wilsonart Sinks): Cast items of homogenous material composed of polyester and acrylic resins, fire-retardant filler materials, and coloring agents.

1.3 SUBMITTALS

- A. Comply with Section 01 33 00, unless otherwise indicated.
- B. Product Data:
 - 1. Detailed specification of construction and fabrication.
 - 2. Manufacturer's installation instructions.
 - 3. Manufacturer's detailed recommendations for handling, storage, installation, protection, and maintenance.

- C. Shop Drawings: Installation details including location and layout of each type of fabrication and accessory.
- D. Samples: Full range of standard colors and patterns.
- E. Contract Closeout Submittals: Comply with Contract Documents.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Wilsonart certified solid surface fabricator/installer.
- B. Installer Qualifications: Firm experienced in installation or application of systems similar in complexity to those required for this Project, including specific requirements indicated.
 - 1. Acceptable to or licensed by manufacturer.
- C. Source Limitations: Obtain materials and products from single source.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fabrications appropriately wrapped in protective materials.
- B. Protect fabrications from damage.

1.6 PROJECT CONDITIONS

A. Maintain relative humidity planned for building occupants and an ambient temperature between 65 and 75_F[□] for 48 hours prior to and during installation. After installation, maintain relative humidity and ambient temperature planned for building occupants.

1.7 WARRANTY

A. Furnish manufacturer's limited 10 year warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Wilsonart International, (800) 433-3222, <u>www.wilsonart.com</u>.
 - 1. Gibraltar Solid Surface, Type 051.
 - 2. Earthstone Solid Surface, Type 051.
- B. Substitutions: Permitted, in accordance with Section 01 25 00 Substitution Procedures.

2.2 GIBRALTAR SOLID SURFACE SHEET

- A. Nominal sheet thickness: 0.50 inch (13 mm)
- B. Surface burning characteristics in accordance with ASTM E 84: Class I or A, and as follows:
 - 1. Flame spread: < 25.
 - 2. Smoke developed: <25.
- C. Liquid Absorption, ISO 4586-2, for 1/2 inch material thickness: 0.4 percent after 2 hour period.
- D. Izod Impact, ASTM D 256, Method A: 0.3 foot pounds per inch.

- E. Tensile Modulus, ASTM D 638 Nominal: 1.2 million pounds per square inch.
- F. Thermal Expansion, ASTM D 696: 0.000018 inch per inch per degree F, maximum.
- G. Hardness, ASTM D 2583, Barcol Impressor: 57.
- H. Flexural Toughness, ASTM D 790: 3 (in.-lb,/in³).
- I. Deflection Temperature under load, ASTM D 648: 90 degrees C.
- J. Stain Resistance, ANSI Z-124.3 Modified; 3.4: No effect.
- K. Boiling Water Resistance, NEMA LD 3-3.05: No effect.
- L. High Temperature Resistance, NEMA LD 3-3.06: No effect.
- M. Radiant Heat Resistance, NEMA LD 3-3.10: No effect.
- N. Light Resistance, NEMA LD 3-3.03: No effect.
- O. Ball Impact Resistance, NEMA LD 3-3.08, one half pound ball, unsupported: 125 inches.
- P. Specific Gravity (Density ASTM D792): 1.60 grams per cubic centimeter.
- Q. Approximate weight: 4.20 pounds per square foot.
- R. Weatherability, ASTM D 2565: Pass.
- S. Fungus Resistance, ASTM G 21: Pass.
- T. Bacterial Resistance, ASTM G 22: Pass.
- U. Pittsburgh Protocol Toxicity: 66.9 grams.
- V. Patterns and Finishes: Selected from manufacturer's full range of available selections (*standard*) by Architect.

2.3 EARTHSTONE SOLID SURFACE SHEET

- A. Nominal sheet thickness: 0.50 inch (13 mm).
- B. Surface burning characteristics in accordance with ASTM E 84: Class II or B, and as follows:
 - 1. Flame spread: < 26.
 - 2. Smoke developed: < 35.
- C. Liquid Absorption, ISO 4586-2, for 1/2 inch material thickness: 0.4 percent after 2 hour period.
- D. Izod Impact, ASTM D 256, Method A: 0.3 foot pounds per inch.
- E. Tensile Modulus, ASTM D 638 Nominal: 1.1 million pounds per square inch.
- F. Thermal Expansion, ASTM D 696: 0.00002 inch per inch per degree F, maximum.
- G. Hardness, ASTM D 2583, Barcol Impressor: 57.
- H. Flexural Toughness, ASTM D 790: 5 (in.-lb,/in³).
- I. Deflection Temperature under load, ASTM D 648: 90 degrees C.
- J. Stain Resistance, ANSI Z-124.3 Modified; 3.4: No effect.
- K. Boiling Water Resistance, NEMA LD 3-3.05: No effect.
- L. High Temperature Resistance, NEMA LD 3-3.06: No effect.
- M. Radiant Heat Resistance, NEMA LD 3-3.10: No effect.
- N. Light Resistance, NEMA LD 3-3.03: No effect.
- O. Ball Impact Resistance, NEMA LD 3-3.08, one half pound ball, unsupported: 125 inches.
- P. Specific Gravity (Density ASTM D792): 1.56 grams per cubic centimeter.
- Q. Approximate weight: 4.10 pounds per square foot.
- R. Fungus Resistance, ASTM G 21: Pass.
- S. Bacterial Resistance, ASTM G 22: Pass.
- T. Pittsburgh Protocol Toxicity: 65.4 grams.
- U. Patterns and Finish: Selected from manufacturer's full range of available selections (standard) by Architect.

2.4 ACCESSORY MATERIALS

- A. Joint adhesive: Manufacturer's standard adhesive to create inconspicuous, nonporous joints, with a chemical bond (WA8215).
- B. Sealant: Standard mildew resistant, FDA/UL recognized silicone sealant in color matched or clear formulations.

C. Sink/bowl mounting hardware: Manufacturer's approved bowl clips, brass inserts and fasteners for attachment of undermount sinks/bowls.

2.5 FABRICATION

- A. Fabrication to be performed by a Wilsonart certified solid surface fabricator/installer.
- B. Fabricate components in shop to greatest extent practical to size and shape indicated, in accordance with approved shop drawing and Wilsonart published requirements.
- C. Wilsonart Solid Surface Fabrication Manual (SS0319)
- D. Form joints between components using manufacture's standard joint adhesive. Joints shall be inconspicuous in appearance and without voids. Attach 4" (100mm) wide Gibraltar/Earthstone reinforcing strip under joints required by Deck Seam Section of the Wilsonart Solid Surface Fabrication Manual (SS0319).
- E. Provide holes and cutouts for plumbing and bath accessories as indicated on shop drawings.
- F. Rout and finish component edges to a smooth, uniform finish. Rout all cutouts then sand all edges smooth. Repair or reject defective or inaccurate work.
- G. Finish: Surfaces shall have a uniform finish.
 - 1. Matte: Standard finish for high traffic areas, requires the least amount of maintenance.
 - 2. Satin: Standard finish for darker Gibraltar and Earthstone patterns, requires minimal maintenance.
 - 3. Semi-gloss: Higher sheen with greater reflectance, suggested for lower traffic areas, requires increased maintenance
 - 4. Gloss: Maximum sheen and reflectance, recommended for light traffic areas or vertical applications.
- H. Thermoforming (optional): Comply with forming data from manufacturer.
 - 1. Construct matching molds to form components shape.
 - 2. Form pieces to shape prior to seaming and joining.
 - 3. Cut pieces larger than finished dimensions, sand edges, remove all nicks and scratches.
 - 4. Heat entire component uniformly between 280°–325°F during forming.
 - 5. Prevent blistering, whitening or cracking of Gibraltar/Earthstone during forming.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive solid surfacing. Identify conditions detrimental to proper or timely installation. Do not commence installation until conditions have been corrected.

3.2 PREPARATION

A. Precondition Wilsonart Solid Surfacing in accordance with manufacturer's printed installation instructions.

3.3 INSTALLATION

- A. Install components plumb and level, in accordance with approved shop drawings, project installation details and manufacturer's printed instructions.
- B. Form joints using manufacturer's approved adhesive, with joints inconspicuous in finished work.
- C. Adhere undermount sinks/bowls to countertop using manufacturer's recommended joint adhesive.
- D. Adhere topmount sinks/bowls to countertop using manufacturer's recommended adhesive/silicone sealant.
- E. Provide backsplashes and endsplashes as indicated on the drawings. Adhere to countertops using

manufacturer's recommended silicone sealant.

- F. Remove excessive adhesive and sealants. Components shall be clean on Date of Substantial Completion.
- G. Coordinate plumbing installation with Division 22.

3.4 INSTALLATION OF WINDOW STOOLS

- A. Install window stools full length of window, set securely into place using only concealed fasteners and manufacturer's approved adhesive.
- B. Window stools shall be plumb, true and level.
- C. Provide minimum 1/8" expansion gaps on both sides of window stools, sealed with Manufacturer's approved sealant.
- D. Ease edges and sand smooth.

3.5 INSTALLATION OF VANITIES

- A. Install plumb, level, true and straight. Shim as necessary using concealed shims.
- B. Attach top securely to base unit or support brackets in accordance with manufacturer's printed instructions.
- C. Seal between wall and component with manufacturer's recommended silicone sealant.
- D. Attach backsplashes and endsplashes to countertops using manufacturer's recommended silicone sealant.

3.6 PROTECTION

- A. Protect surfaces from damage until Date of Substantial Completion. Repair or replace damaged components that cannot be repaired to architect's satisfaction.
- B. Fabricator/Installer to provide the Wilsonart® Care and Maintenance kit, review maintenance procedures and the Wilsonart warranty with the head of maintenance upon completion of project.

END OF SECTION

SECTION 07 21 00 - BUILDING INSULATION

PART 1 - GENERAL

1.0 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Fiberglass roll or batt insulation
- B. Related Sections include the following:
 - 1. Section 09 21 16.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: Full-size units for each type of exposed insulation indicated.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for insulation products.
- D. Research/Evaluation Reports: For foam-plastic insulation.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of building insulation through one source.
- B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-testresponse characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

- 1. Surface-Burning Characteristics: ASTM E 84.
- 2. Fire-Resistance Ratings: ASTM E 119.
- 3. Combustion Characteristics: ASTM E 136.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect 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 plastic insulating materials to Project site before installation time.
 - 3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

Batt or Roll Insulation:

- 1. Johns Manville
- 2. Owens Corning
- 3. Certainteed

2.2 INSULATING MATERIALS

- A. General: Provide insulating materials that comply with requirements and with referenced standards.
 - 1. Preformed Units: Sizes to fit applications indicated; selected from manufacturer's standard thicknesses, widths, and lengths.
 - 2. <u>General:</u> Insulation shall be fine fiber, flexible, resilient glass fiber blanket. Moisture absorption shall be less than .2% by volume.
 - 1. Interior Stud Walls: 3 5/8" x 16" wide x 96" sound attenuation batts "R" factor 11. Unfaced.
 - 2. Interior Stud Walls: 6" x 16" wide x 96" sound attenuation batts "R" factor 19. Unfaced
 - 3. Above Acoustical Ceilings: 6" x 24" wide x 96" thermal batt insulation kraft faced fiberglass. "R" factor 19

AUXILIARY INSULATING MATERIALS

A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for Sections in which substrates and related work are specified and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances harmful to insulations or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.
- B. Close off openings in cavities receiving poured-in-place insulation to prevent escape of insulation. Provide bronze or stainless steel screens (inside) where openings must be maintained for drainage or ventilation.

3.3 INSTALLATION, GENERAL

- A. Comply with insulation manufacturers written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Water-Piping Coordination: If water piping is located on inside of insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.
- E. Apply single layer of insulation to produce thickness indicated, unless multiple layers are required to make up total thickness.

3.4 INSTALLATION OF GENERAL BUILDING INSULATION

- A. Apply insulation units to substrates by method complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Set vapor-retarder-faced units with vapor retarder to warm side of construction. Do not obstruct ventilation spaces, except for firestopping.

- 1. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.
- C. Apply spray foam insulation in strict compliance with insulation manufacturers' written recommendations by manufacturer approved applicator only. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make it even with studs by using method recommended by insulation manufacturer.

END OF SECTION

SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 SECTION REQUIREMENTS

A. Submittals: Product Data and color Samples.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS

- A. Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under service and application conditions.
- B. Elastomeric Sealants: Comply with ASTM C 920.
 - 1. Single-component, neutral-curing silicone sealant, Type S; Grade NS; Class 25; Uses T, M, and O, with the additional capability to withstand [50 percent movement in both extension and compression for a total of 100 percent movement] [100 percent movement in extension and 50 percent movement in compression for a total of 150 percent movement]. Use for building expansion joints.
 - 2. Single-component, nonsag polysulfide sealant, Type S; Grade NS; Class 12-1/2; Uses NT, M, G, A, and O. For general exterior use.
 - 3. Single-component, neutral-curing silicone sealant, Type S; Grade NS; Class 25; Uses T, NT, M, G, A, and O. For general exterior use.
 - 4. Single-component, nonsag urethane sealant, Type S; Grade NS; Class 25; and Uses NT, M, A, and O. For general exterior use.
 - 5. Single-component, nonsag urethane sealant, Type S; Grade NS; Class 25; Uses T, NT, M, G, A, and O. Use for exterior traffic-bearing joints, where slope precludes use of pourable sealant.
 - 6. Single-component, pourable urethane sealant, Type S; Grade P; Class 25; Uses T, M, G, A, and O. Use for exterior traffic-bearing joints.
 - 7. Single-component, mildew-resistant silicone sealant, Type S; Grade NS; Class 25; Uses NT, G, A, and O; formulated with fungicide. Use for interior sealant joints in ceramic tile, stone, and other hard surfaces in kitchens and toilet rooms and around plumbing fixtures.

- C. Latex Sealant: Single-component, nonsag, mildew-resistant, paintable, acrylic-emulsion sealant complying with ASTM C 834. For interior use only at perimeters of door and window frames.
- D. Acoustical Sealant for Exposed Joints: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834. For interior use only at acoustical assemblies.
- E. Acoustical Sealant for Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce transmission of airborne sound. For interior use only at acoustical assemblies.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with ASTM C 1193.
- B. Comply with ASTM C 919 for use of joint sealants in acoustical applications.

END OF SECTION

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. Section Includes:
 - 1. Standard hollow metal doors and frames.
- B. Related Sections:
 - 1. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
 - 2. Division 08 Section "Wood Doors" for wood doors in hollow metal frames.
 - 3. Division 08 Section "Door Hardware (Scheduled by Describing Products)" for door hardware for hollow metal doors and frames.
 - 4. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.

1.4 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings.
- B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, temperature-rise ratings, and finishes.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door design.
 - 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 4. Locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of anchorages, joints, field splices, and connections.
 - 7. Details of accessories.
 - 8. Details of moldings, removable stops, and glazing.
- C. Samples for Verification:
 - 1. Samples are only required by request of the architect and for manufactures that are not current members of Steel Door Institute.
 - 2. For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches (75 by 125 mm).
 - 3. For the following items, prepared on Samples about 12 by 12 inches (305 by 305 mm) to demonstrate compliance with requirements for quality of materials and construction:
 - a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
 - b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow metal panels and glazing if applicable.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.
- B. Preinstallation Conference: Conduct conference at Project site for hollow metal frames requiring electrical knockout boxes to verify installation of conduit on frames.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Projectsite storage. Do not use nonvented plastic.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch- (102-mm-) high wood blocking. Do not store in a manner that traps excess humidity.
 - 1. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.9 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with this section requirements, provide products by one of the following:
 - 1. Amweld Building Products, LLC.
 - 2. Ceco Door Products; an Assa Abloy Group company.
 - 3. Curries Company; an Assa Abloy Group company.
 - 4. Steelcraft; an Ingersoll-Rand company.
 - 5. No Substitution; only material from an SDI member will be allowed on the jobsite unless prior approval is given in accordance with substitution request requirements per General Requirements section.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheets: Carbon steel complying with ASTM A 366 (ASTM A 366M), commercial quality, or ASTM A 620 (ASTM A 620M), drawing quality, special killed.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- C. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z (12G) coating designation; mill phosphatized.
 - 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- E. Glazing: Comply with requirements in Division 08 Section "Glazing."

2.3 STANDARD HOLLOW METAL DOORS

- A. General: Provide 1 3/4" thick beveled and handed doors of design indicated, fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.
 - 1. Design: Flush panel

- 2. Core Construction: Manufacturer's standard polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.
- 3. Vertical Edges for Single-Acting Doors: Beveled edge
 - a. Beveled Edge: 1/8 inch in 2 inches (3 mm in 50 mm).
- 4. Vertical Edges for Double-Acting Doors: Round vertical edges with 2-1/8-inch (54-mm) radius.
- 5. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- (1.0-mm-) thick, end closures or channels of same material as face sheets.
- 6. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheets. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
 - 1. Level 2 and Physical Performance Level A (Heavy Duty), 16 gage (0.053-inch 1.3-mm-) thick steel faces, with threat side of door exceeding 14 gage (0.067-inch 1.7-mm-) thick steel, Model 2 (Seamless face and edges).
 - 2. Provide doors with 22 gage Z-Channels steel stiffeners placed at 6 inches apart with foamed in place polyurethane core.
 - 3. Provide thermal insulation with calculated R factor of 11.01 per ASTM C518 Standards.
- C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
 - 1. Level 3 and Physical Performance Level A (Extra Heavy Duty), minimum 16 gauge (0.053-inch 1.3-mm-) thick steel, Model 2 (Seamless face and edges).
- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.4 STANDARD HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated from metallic-coated steel sheets.
 - 1. Fabricate frames with mitered or coped corners.
 - 2. Fabricate frames as face welded joints and back weld joints continuously, unless otherwise indicated.
 - 3. Frames for Level 3 Steel Doors: minimum 14 gauge 0.067-inch- (1.7-mm-) thick steel sheet.
 - Interior Frames: Fabricated from cold-rolled steel sheet unless metallic-coated sheet is indicated.
 - 1. Fabricate frames with mitered or coped corners.
 - 2. Fabricate frames as face welded unless otherwise indicated.
 - 3. Fabricate knocked-down, drywall slip-on frames for in-place gypsum board partitions.
 - 4. Frames for Level 3 Steel Doors: minimum 16 gauge 0.053-inch- (1.3-mm-) thick steel sheet.
 - 5. Frames 48-inches and wider in opening width are required to be minimum 14 gauge 0.067-inch-(1.7-mm-) thick steel sheet.

C.

- 6. Frames for Wood Doors: minimum 16 gauge 0.053-inch- (1.3-mm-) thick steel sheet.
- 7. Frames for Borrowed Lights: minimum 16 gauge 0.053-inch- (1.3-mm-) thick steel sheet.
- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (50 mm) wide by 10 inches (250 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
 - 2. Stud-Wall Type: Designed to engauge stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
 - 3. Compression Type for Drywall Slip-on (Knock-Down) Frames: Adjustable compression anchors.
- B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, and as follows:
 - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 - 2. Separate Topping Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.6 STOPS AND MOLDINGS

- A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch (0.8 mm) thick, fabricated from same material as door face sheet in which they are installed.
- B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated.
- C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch (0.8 mm) thick, fabricated from same material as frames in which they are installed.

2.7 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Grout Guards: Formed from same material as frames, not less than 0.016 inches (0.4 mm) thick.

2.8 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8
- C. Hollow Metal Doors:

- 1. Exterior Doors:
 - a. Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Top of door to be flush and completely sealed joints in top edges of doors against water penetration.
 - b. Provide Polyurethane core.
- 2. Glazed Lites: Factory cut openings in doors with applied flush trim to fit.
- 3. Astragals: Provide overlapping astragal as noted in door hardware sets in Division 8 Door Hardware on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted.
- 4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 8 Door Hardware.
- 5. Seamless Edge: Provide seamless edge on hollow metal doors by intermittently tack welding seam, grinding smooth and finishing edge free from defects and blemishes.
- D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible. Continuously backweld joints at exterior frames.
 - 2. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 - 3. Equal Rabbet Frames: Provide frames with equal rabbet dimensions unless glazing and removable stops required wider dimension on glass side of frame.
 - 4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 42-inch and wider with mortise/butt type hinges only at top hinge location to deter against hinge reinforcement sag.
 - 5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 8 Door Hardware.
 - 6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops; provide security head screws at exterior locations.
 - 7. Grout Guards: Weld guard boxes to frame at back of mortise hardware prep in frames at all hinge, strike and other recessed hardware preps regardless of grouting requirements.
 - 8. Provide A60 Galvannealed coating at frames in restrooms with showers/Jacuzzi, clean areas such as surgery rooms and surgical suites, clean rooms, and soil rooms.
 - 9. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 - 10. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
 - 1) Two anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - 3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
 - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.
 - b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:

- 1) Three anchors per jamb up to 60 inches (1524 mm) high.
- 2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
- 3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
- 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.
- 5) Two anchors per head for frames above 42 inches (1066 mm) wide and mounted in metal-stud partitions.
- 11. Door Silencers: Except on weather-stripped or gasketed doors, drill stops to receive door silencers as follows. Keep holes clear during construction. Silencers to be supplied by frame manufacture regardless if specified in division 8 Door Hardware.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.
- F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
 - 1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 - 2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
 - 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
- G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricators shop
 - 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
 - 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that glazed lites are capable of being removed independently.
 - 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 - 4. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.
 - 5. Gap for butted or mitered joints in glass stop should not exceed .0625-inch.

2.9 STEEL FINISHES

- A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:
 - 1. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - 2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - 3. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - 4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.
 - 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-protection-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable glazing stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.

- e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
- f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
- g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.
- 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post installed expansion anchors.
 - a. Floor anchors may be set with powder-actuated fasteners instead of post installed expansion anchors if so indicated and approved on Shop Drawings.
- 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind 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 grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
- 6. Field Supplied Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
- 7. Grouting Requirements:
 - a. Do not grout head of frames unless reinforcing has been installed in head of frame.
 - b. Do not grout vertical or horizontal closed mullion members.
- 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 (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), 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 Standard Steel Doors:
 - a. Jambs and Head: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
 - b. Between Edges of Pairs of Doors: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch (9.5 mm).
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (19 mm).
 - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 - 3. Smoke-Control Doors: Install doors according to NFPA 105.
- D. Glazing: Comply with installation requirements in Division 08 Section "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 (230 mm) o.c. and not more than 2 inches (50 mm) o.c. from each corner.
 - a. Secure exterior removable stops with security head screws.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

SECTION 08 14 16 – FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. Section Includes:
 - 1. Solid-core doors and transom panels with wood-veneer, hardboard or MDF and decorative-laminate faces.
 - 2. Factory finishing wood doors.
 - 3. Factory fitting wood doors to frames and factory machining for hardware.
- B. Related Sections:
 - 1. Division 6 Section "Interior Architectural Woodwork" for requirements for veneers from the same flitches for both wood doors and wood paneling.
 - 2. Division 8 Section "Steel Doors and Frames" for astragals provided as part of a fire-rated labeled assembly and for door silencers provided as part of the frame.
 - 3. Division 8 Section "Glazing" for glass view panels in wood doors.

1.4 SUBMITTALS

- A. Product Data: For each type of door indicated. Include details of core and edge construction, louvers, and trim for openings. Include factory-finishing specifications.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
 - 1. Indicate dimensions and locations of mortises and holes for hardware.
 - 2. Indicate dimensions and locations of cutouts.

- 3. Indicate requirements for veneer matching.
- 4. Indicate doors to be factory finished and finish requirements.
- 5. Indicate fire-protection ratings for fire-rated doors.
- C. Samples for Initial Selection: For decorative-laminate door faces and factory-finished doors.
- D. Samples for Verification:
 - 1. As requested by the Architect for verification, provide factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.
- E. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain wood doors from single manufacturer wherever possible.
- B. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, latest edition, "Industry Standard for Architectural Wood Flush Doors."
- C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons and wrap bundles of doors in plastic sheeting.
- C. Mark each door on top rail with opening number used on Shop Drawings.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
 - b. Telegraphing of core construction in wood face veneers exceeding 0.01 inch in a 3-inch span.

- c. Telegraphing of core construction and delamination of face in decorative laminate-faced doors.
- 2. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 DOOR CONSTRUCTION, GENERAL

- A. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.
- B. Particleboard-Core Doors:
 - 1. Particleboard: ANSI A208.1.
- C. Fire-Protection-Rated Doors: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
 - 1. Edge Construction: Provide all fire-rated doors edge construction with intumescent seals concealed by outer stile (Category A). Comply with specified requirements for exposed edges.
 - 2. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
- D. Mineral-Core Doors:
 - 1. Core: Non-combustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
 - 2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware.
 - 3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screwholding capability and split resistance. Comply with specified requirements for exposed edges.

2.2 VENEERED-FACED DOORS FOR TRANSPARENT FINISH

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Graham.
 - 2. Algoma Hardwoods.
 - 3. Eggers Industries.
 - 4. Marshfield Door Systems, Inc.
 - 5. V-T Industries Inc.
- B. Interior Solid-Core Doors:
 - 1. Grade: Premium, with Grade A faces.
 - 2. Species: Select White Birch.
 - 3. Cut: Rotary Cut.
 - 4. Match between Veneer Leaves: Book match.
 - 5. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
 - 6. Room Match: Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 10 feet or more.

- 7. Exposed Vertical Edges: Same species as faces.
- 8. Core: Particleboard type LD-2, Mineral core.
- 9. Construction: Five plies. Stiles and rails are bonded to core, and then entire unit abrasive planed before veneering.

2.3 LOUVERS AND LIGHT FRAMES

- A. Metal Louvers:
 - 1. Blade Type: Vision-proof inverted V or inverted Y.
 - 2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with bakedenamel- or powder-coated finish.
- B. Louvers for Fire-Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire-protection rating of 1-1/2 hours and less.
 - 1. Manufacturers: Subject to compliance with requirements, provide door manufacturers standard louver to meet rating indicated.
 - 2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with bakedenamel- or powder-coated finish.
- C. Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold-rolled steel sheet; with baked-enamel or powder-coated finish; and approved for use in doors of fire-protection rating indicated.

2.4 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 - 1. Comply with requirements in NFPA 80 for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
 - 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
 - 2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of firerated doors.
- C. Openings: Cut and trim openings through doors in factory.
 - 1. Light Openings: Trim openings with moldings of material and profile indicated.

2.5 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 - 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

- B. Finish doors at factory that are indicated to receive transparent finish. Field finish doors indicated to receive opaque finish.
- C. Transparent Finish:
 - 1. Grade: Premium.
 - 2. Finish: WDMA TR-6 catalyzed polyurethane.
 - 3. Staining: As selected by Architect from manufacturer's full range.
 - 4. Effect: Semi-filled finish, produced by applying an additional finish coat to partially fill the wood pores.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames before hanging doors.
 - 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 - 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Division 8 Section "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
 - 1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
- C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

- A. Operation: Re-hang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION

SECTION 08 41 13 – ALUMINUM STOREFRONT

PART 1 - GENERAL

1.0 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.1 SUMMARY

- A. Related Documents: Conditions of the Contract, Division 1 General Requirements, and Drawings apply to Work of this Section.
- B. Section Includes:
 - 1. Entrance and storefront systems, complete with reinforcing, fasteners, anchors and attachment devices.
 - 2. Aluminum doors complete with hardware.
 - 3. Accessories necessary to complete work.
- C. Related Sections:
 - 1. Section 01 40 00 Quality Requirements.
 - 2. Section 05 50 00 Metal Fabrications.
 - 3. Section 06 10 00 Rough Carpentry.
 - 4. Section 07 92 00 Joint Sealants.
 - 5. Section 08 71 00 Door Hardware.
 - 6. Section 08 81 00 Glass and Glazing.

1.2 REFERENCES

- A. Aluminum Association (AA):
 - 1. DAF-45 Designation System for Aluminum Finishes.

B. American Architectural Manufacturers Association (AAMA):

- 1. 503.1 Test Method for Condensation Resistance of Windows, Doors and Glazed Wall Systems.
- 2. 701.2 Specifications for Pile Weatherstripping.
- 3. Manual #10 Care and Handling of Architectural Aluminum From Shop to Site.
- 4. SFM-1 Aluminum Storefront and Entrance Manual.
- C. American National Standards Institute (ANSI):
 - 1. A117.1 Safety Standards for the Handicapped.

D. American Society for Testing and Materials (ASTM):

American Society for Testing and Materials (ASTM).		
1.	A36	Structural Steel.
2.	B209	Aluminum and Aluminum - Alloy Sheet and Plate.
3.	B221	Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and
		Tubes.
4.	B308	Aluminum-Alloy 6061-T6 Standard Structural Shapes,
		Rolled or Extruded.
5.	C509	Cellular Elastomeric Pre-formed Gasket and Sealing
		Material.
6.	C864	Dense Elastomeric Compression Seal Gaskets, Setting
		Blocks and Spacers.
7.	E283	Test Method for Rate of Air Leakage Through Exterior
		Windows, Curtain Walls and Doors.
8.	E330	Test Method for Structural Performance of Exterior
		Windows, Curtain Walls and Doors by Uniform Static Air
		Pressure Difference.
9.	E331	Test Method for Water Penetration of Exterior Windows,
		Curtain Walls and Doors by Uniform Static Air Pressure
		Difference.

- E. Federal Specifications (FS):
 1. TT-P-645A Primer, Paint, Zinc Chromate, Alkyd Type.
- F. Steel Structures Painting Council (SSPC):
 - 1. Paint 12 Cold-Applied Asphalt Mastic (Extra Thick Film).

1.3 SYSTEM REQUIREMENTS

- A. Design Requirements:
 - 1. Drawings are diagrammatic and do not purport to identify nor solve problems of thermal or structural movement, glazing, anchorage or moisture disposal.
 - 2. Requirements shown by details are intended to establish basic dimension of units, sight lines and profiles of members.
 - 3. Provide concealed fastening.
 - 4. Provide entrance and storefront systems, including necessary modifications, to meet specified requirements and maintaining visual design concepts.
 - 5. Attachment considerations are to take into account site peculiarities and expansion and contraction movements so there is no possibility of loosening, weakening or fracturing connection between units and building structure or between units themselves.
 - 6. Anchors, fasteners and braces shall be structurally stressed not more than 50% of allowable stress when maximum loads are applied.
 - 7. Provide for expansion and contraction without detriment to appearance or performance.
 - 8. Assemblies shall be free from rattles, wind whistles and noise due to thermal and structural movement and wind pressure.
- B. Performance Requirements:
 - 1. Air infiltration: Air leakage through fixed light areas of storefront shall not exceed 0.06 cfm per square foot (0.0003 m3/sm2) of surface area when tested in accordance with ASTM E283 at differential static pressure of 6.24 psf (300 Pa).
 - 2. Water infiltration: No uncontrolled water penetration when tested in accordance with ASTM E 331 at test pressure of 8.0 psf 380 Pa.
- C. Thermal Requirements:
 - 1. Framing systems shall accommodate expansion and contraction movement due to surface temperature differentials of 180 degrees Fahrenheit (82 degrees Celsius) without causing buckling, stress on glass, failure of joint seals, excessive stress on structural elements, reduction of performance, or other detrimental effects.
 - 2. Ensure doors function normally within limits of specified temperature range.
- D. Structural Requirements, as measured in accordance with ANSI/ASTM E330:
 - 1. Wind loads for exterior assemblies:
 - a. Basic loading:
 - 1) [___] psf acting inward.
 - 2) [____] psf acting outward.
 - 2. Deflection: Maximum calculated deflection of any framing member in direction normal to plane of wall when subjected to specified design pressures shall not exceed 1/175 of its clear span.
- E. Testing Requirements: Provide components that have been previously tested by an independent testing laboratory.
- 1.4 SUBMITTALS
 - A. General: Submit in accordance with Section 01 33 00.
 - 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.
 - C. 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. Expansion and contraction provisions.
 - f. Hardware, including locations, mounting heights, reinforcements and special installation provisions.
 - g. Glazing methods and accessories.
 - h. Internal sealant requirements as recommended by sealant manufacturer.
 - 4. Schedule of finishes.
 - D. Samples:
 - 1. Submit samples indicating quality of finish, in required colors, on alloys used for work, in sizes as standard with manufacturer.
 - 2. Where normal texture or color variations are expected, include additional samples illustrating

range of variation.

- E. Test Reports:
 - 1. Standard Systems: Submit certified copies of previous test reports substantiating performance of system in lieu of re-testing. Include other supportive data as necessary.
- F. Certificates:
 - 1. Submit manufacturer's certification stating that systems are in compliance with specified requirements.
- G. Qualification Data:
 - 1. Submit installer qualifications verifying years of experience.
 - 2. Include list of projects having similar scope of work identified by name, location, date, reference name and phone number.
- H. Manufacturer's Instructions: Submit manufacturer's printed installation instructions.

1.5 QUALITY ASSURANCE

- A. Single Source Responsibility:
 - 1. To ensure quality of appearance and performance, obtain materials for each system from either a single manufacturer or from manufacturer approved by each system manufacturer.
- B. Installer Qualifications: Certified in writing by Contractor as qualified for installation of specified systems.
- C. Perform Work in accordance with AAMA SFM-1 and manufacturer's written instructions.
- D. Conform to requirements of ANSI A117.1 and local amendments.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Comply with requirements of Section 01 60 00.
- B. Protect finished surfaces as necessary to prevent damage.
- C. Do not use adhesive papers or sprayed coatings which become firmly bonded when exposed to sun.
- D. Do not leave coating residue on any surfaces.
- E. Replace damaged units.

1.7 WARRANTY

- A. Provide warranties in accordance with the Contract General Conditions.
- B. Provide written manufacturer's warranty, executed by company official, warranting against defects in materials and products for two (2) years from date of Substantial Completion.
- C. Provide written installer's warranty, warranting work to be watertight, free from defective materials, defective workmanship, glass breakage due to defective design, and agreeing to replace components which fail within 1 year from date of Substantial Completion.
 - 1. Warranty shall cover following:
 - a. Complete watertight and airtight system installation within specified tolerances.

- b. Completed installation will remain free from rattles, wind whistles and noise due to thermal and structural movement and wind pressure.
- c. System is structurally sound and free from distortion.
- d. Glass and glazing gaskets will not break or "pop" from frames due to design wind, expansion or contraction movement.
- e. Glazing sealants and gaskets will remain free from abnormal deterioration or dislocation due to sunlight, weather or oxidation.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Manufacturers
 - 1. YKK AP America, Inc.
 - 2. Vista Wall Architectural Products
 - 3. Kawneer
 - 4. Oldcastle Building Envelope
- B. Substitutions: Submit under provisions of Section 01 25 00, a minimum of 10 days prior to bid date.
- C. Acceptable Entrance Doors:
 - Monumental Swing Doors: YKK AP Series 50M Swing Doors.
 50M Description: 2" (54.0 mm) thick heavy wall door stile by 5" (127.0 mm) with mid-panel panic device system or equivalent by specified manufacturer.
- D. Acceptable Storefront Framing Systems:
 - 1. Framing System: YES 45 FI (2" x 4-1/2") YKK AP or equivalent by specified manufacturer.

2.2 FRAMING MATERIALS AND ACCESSORIES

- A. Aluminum:
 - 1. ASTM B221, alloy 6063-T5 for extrusions; ASTM B209, alloy 5005-H34 for sheets; or other alloys and temper recommended by manufacturer appropriate for specified finish.
- B. Internal Reinforcing:
 - 1. ASTM A36 for carbon steel; or ASTM B308 for structural aluminum.
 - 2. Shapes and sizes to suit installation.
 - 3. Shop coat steel components after fabrication with alkyd type zinc chromate primer complying with FS TT-P-645.
- C. Anchorage Devices:
 - 1. Manufacturer's standard formed or fabricated steel or aluminum assemblies of shapes, plates, bars or tubes.
- D. Fasteners:
 - 1. Aluminum, non-magnetic stainless steel or other materials warranted by manufacturer to be noncorrosive and compatible with components being fastened.

- 2. Do not use exposed fasteners, except where unavoidable for application of hardware.
- 3. For exposed locations, provide countersunk Phillips head screws with finish matching items fastened.
- 4. For concealed locations, provide manufacturer's standard fasteners.
- 5. Provide nuts or washers of design having means to prevent disengagement; deforming of fastener threads is unacceptable.
- E. Expansion Anchor Devices: Lead-shield or toothed-steel, drilled-in, expansion bolt anchors.
- F. Protective Coatings: Cold-applied asphalt mastic complying with SSPC-Paint 12, compounded for 30 mil (0.77 mm) thickness for each coat; or alkyd type zinc chromate primer complying with FS TT-P-645.
- G. Glazing Gaskets:
 - 1. Compression type design, replaceable, molded or extruded, of neoprene, or ethylene propylene diene monomer (EPDM).
 - 2. Conform to ASTM C509 or C864.
 - 3. Profile and hardness as required to maintain uniform pressure for watertight seal.
 - 4. Provide in manufacturer's standard black color.
- H. Weatherstripping:
 - 1. Wool pile conforming to AAMA 701.2; or extruded EPDM elastomeric conforming to ASTM C509 or C864.
 - 2. Provide EPDM or vinyl-blade gasket weatherstripping in bottom door rail, adjustable for contact with threshold.
- I. Internal Sealants: Types recommended by sealant manufacturer.
- J. "Anti-Walk" Edge Blocking: "W" shaped EPDM blocks for use in keeping glazing material stationary under vibration or seismic loading.
- K. Baffles (at weep holes): Type as recommended by system manufacturer and shown in published installation instructions.
- 2.3 GLASS AND GLAZING ACCESSORIES
 - A. Refer to Section 08 81 00.

2.4 FABRICATION

- A. Coordination of Fabrication:
 - 1. Check actual frame or door openings required in construction work by accurate field measurements before fabrication.
 - 2. Fabricate units to withstand loads which will be applied when system is in place.
- B. General:
 - 1. Conceal fasteners wherever possible.
 - 2. Reinforce work as necessary for performance requirements and for support to structure.
 - 3. Separate dissimilar metals and aluminum in contact with concrete utilizing protective coating or pre-formed separators which will prevent contact and corrosion.
 - 4. Comply with Section 08 81 00 for glazing requirements.
- C. Aluminum Framing:
 - 1. Provide members of size, shape and profile indicated, designed to provide for glazing from interior.
 - 2. Fabricate frame assemblies with joints straight and tight fitting.

- 3. Reinforce internally with structural members as necessary to support design loads.
- 4. Maintain accurate relation of planes and angles, with hairline fit of contacting members.
- 5. Seal horizontals and direct moisture accumulation to exterior.
- 6. Provide flashings and other materials used internally or externally that are corrosive resistant, non-staining, non-bleeding and compatible with adjoining materials.
- 7. Provide manufacturer's extrusions and accessories to accommodate expansion and contraction due to temperature changes without being detrimental to appearance or performance.
- 8. Make provisions in framing for minimum edge clearance, nominal edge cover and nominal pocket width for thickness and type of glazing or infill used in accordance with recommendations of manufacturer and FGMA Glazing Manual.
- 9. Provide tight fitting, injection molded, plastic water deflectors at all intermediate horizontals.
- D. Entrance Doors:
 - 1. Fabricate with mechanical joints using internal reinforcing plates and shear blocks attached with fasteners and by welding.
 - 2. Provide extruded aluminum glazing stops of beveled and mitered for single glazing only design, permanently anchored on security side and removable on opposite side.

E. Hardware:

- 1. Receive hardware supplied in accordance with Section 08 71 00 and install in accordance with requirements of this Section.
- 2. Cut, reinforce, drill and tap frames and doors as required to receive hardware.
- 3. Comply with hardware manufacturer's templates and instructions.
- 4. Use concealed fasteners wherever possible.
- 5. Coordinate mid-panel panic device system with hardware at storefront doors to ensure compatibility.

F. Welding:

- 1. Comply with recommendations of the American Welding Society.
- 2. Use recommended electrodes and methods to avoid distortion and discoloration.
- 3. Grind exposed welds smooth and flush with adjacent surfaces; restore mechanical finish.

G. Flashings:

1. Form from sheet aluminum with same finish as extruded sections. Apply finish after fabrication. Material thickness as required to suit condition without deflection or "oil-canning".

2.5 FINISH

A. Finish to match existing storefront systems to remain.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions and proceed with Work in accordance with Section 01 40 00.
- B. Verify dimensions, tolerances and method of attachment with other Work.

3.2 INSTALLATION

- A. Erection Tolerances:
 - 1. Limit variations from plumb and level:
 - a. 1/8 inch (3 mm) in 10 feet (3 M) vertically.
 - b. 1/8 inch (3 mm) in 20 feet (6 M) horizontally.
 - 2. Limit variations from theoretical locations: 1/4 inch (6 mm) for any member at any location.
 - 3. Limit offsets in theoretical end-to-end and edge-to-edge alignment: 1/16 inch (2 mm) from flush surfaces not more than 2 inches (51 mm) apart or out-of-flush by more than 1/4 inch (6 mm).
- B. Install doors and hardware in accordance with manufacturer's printed instructions.
- C. Set units plumb, level and true to line, without warp or rack of frame.
- D. Anchor securely in place, allowing for required movement, including expansion and contraction.
- E. Separate dissimilar materials at contact points, including metal in contact with masonry or concrete surfaces, with bituminous paint or pre-formed separators to prevent contact and corrosion.
- F. Seal perimeter members as shown on manufacturer's installation instructions or as required for unique job conditions. Set other members with internal sealants and baffles as called for in manufacturer's installation instructions. Use sealants as recommended by sealant manufacturer.
- G. Coordinate installation of perimeter sealant and backing materials between assemblies and adjacent construction in accordance with requirements of Section 07 92 00.
- H. Glazing: Refer to requirements of Section 08 81 00. Utilize "anti-walk" edge blocking on all vertical edges of glazing.

3.3 ADJUSTING

A. Test door operating functions. Adjust closing and latching speeds and other hardware in accordance with manufacturer's instructions to ensure smooth operation.

3.4 CLEANING

- A. Clean surfaces in compliance with manufacturer's recommendations; remove excess mastic, mastic smears, foreign materials and other unsightly marks.
- B. Clean metal surfaces exercising care to avoid damage.

END OF SECTION

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Mechanical and electrified door hardware
 - 2. Electronic access control system components
- B. Section excludes:
 - 1. Windows
 - 2. Cabinets (casework), including locks in cabinets
 - 3. Signage
 - 4. Toilet accessories
 - 5. Overhead doors
- C. Related Sections:
 - 1. Division 01 Section "Alternates" for alternates affecting this section.
 - 2. Division 06 Section "Rough Carpentry"
 - 3. Division 06 Section "Finish Carpentry"
 - 4. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
 - 5. Division 08 Sections:
 - a. "Metal Doors and Frames"
 - b. "Flush Wood Doors"
 - c. "Stile and Rail Wood Doors"
 - d. "Interior Aluminum Doors and Frames"
 - e. "Aluminum-Framed Entrances and Storefronts"
 - f. "Stainless Steel Doors and Frames"
 - g. "Special Function Doors"
 - h. "Entrances"
 - 6. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
 - 7. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

1.02 REFERENCES

- A. UL LLC
 - 1. UL 10B Fire Test of Door Assemblies
 - 2. UL 10C Positive Pressure Test of Fire Door Assemblies
 - 3. UL 1784 Air Leakage Tests of Door Assemblies
 - 4. UL 305 Panic Hardware
- B. DHI Door and Hardware Institute

DOOR HARDWARE

- 1. Sequence and Format for the Hardware Schedule
- 2. Recommended Locations for Builders Hardware
- 3. Keying Systems and Nomenclature
- 4. Installation Guide for Doors and Hardware
- C. NFPA National Fire Protection Association
 - 1. NFPA 70 National Electric Code
 - 2. NFPA 80 2016 Edition Standard for Fire Doors and Other Opening Protectives
 - 3. NFPA 101 Life Safety Code
 - 4. NFPA 105 Smoke and Draft Control Door Assemblies
 - 5. NFPA 252 Fire Tests of Door Assemblies
- D. ANSI American National Standards Institute
 - 1. ANSI A117.1 2017 Edition Accessible and Usable Buildings and Facilities
 - 2. ANSI/BHMA A156.1 A156.29, and ANSI/BHMA A156.31 Standards for Hardware and Specialties
 - 3. ANSI/BHMA A156.28 Recommended Practices for Keying Systems
 - 4. ANSI/WDMA I.S. 1A Interior Architectural Wood Flush Doors
 - 5. ANSI/SDI A250.8 Standard Steel Doors and Frames

1.03 SUBMITTALS

- A. General:
 - 1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
 - 2. Prior to forwarding submittal:
 - a. Review drawings and Sections from related trades to verify compatibility with specified hardware.
 - b. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
- B. Action Submittals:
 - 1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
 - 2. 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.
 - 3. Door Hardware Schedule:
 - a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.

- b. Submit with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
- c. Indicate complete designations of each item required for each opening, include:
 - 1) Door Index: door number, heading number, and Architect's hardware set number.
 - 2) Quantity, type, style, function, size, and finish of each hardware item.
 - 3) Name and manufacturer of each item.
 - 4) Fastenings and other pertinent information.
 - 5) Location of each hardware set cross-referenced to indications on Drawings.
 - 6) Explanation of all abbreviations, symbols, and codes contained in schedule.
 - 7) Mounting locations for hardware.
 - 8) Door and frame sizes and materials.
 - 9) Degree of door swing and handing.
 - 10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.
- 4. Key Schedule:
 - a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
 - Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
 - c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
 - d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
 - e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
 - f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.
- C. Informational Submittals:
 - 1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
 - 2. Provide Product Data:
 - a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
 - b. Include warranties for specified door hardware.
- D. Closeout Submittals:
 - 1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
 - a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
 - b. Catalog pages for each product.
 - c. Final approved hardware schedule edited to reflect conditions as installed.
 - d. Final keying schedule
 - e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

- f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
- E. Inspection and Testing:
 - 1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:
 - a. Fire door assemblies, in compliance with NFPA 80.
 - b. Required egress door assemblies, in compliance with NFPA 101.

1.04 QUALITY ASSURANCE

- A. Qualifications and Responsibilities:
 - Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
 - 2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
 - 3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
 - a. For door hardware: DHI certified AHC or DHC.
 - b. Can provide installation and technical data to Architect and other related subcontractors.
 - c. Can inspect and verify components are in working order upon completion of installation.
 - d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.
 - 4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.
- B. Certifications:
 - 1. Fire-Rated Door Openings:
 - a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
 - b. Provide only items of door hardware that are listed products tested by UL LLC, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.
 - 2. Smoke and Draft Control Door Assemblies:

DOOR HARDWARE

- a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
- b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.
- 3. Electrified Door Hardware
 - a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
- 4. Accessibility Requirements:
 - a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.
- C. Pre-Installation Meetings
 - 1. Keying Conference
 - a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
 - 1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - 2) Preliminary key system schematic diagram.
 - 3) Requirements for key control system.
 - 4) Requirements for access control.
 - 5) Address for delivery of keys.
 - 2. Pre-installation Conference
 - a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - b. Inspect and discuss preparatory work performed by other trades.
 - c. Inspect and discuss electrical roughing-in for electrified door hardware.
 - d. Review sequence of operation for each type of electrified door hardware.
 - e. Review required testing, inspecting, and certifying procedures.
 - f. Review questions or concerns related to proper installation and adjustment of door hardware.
 - 3. Electrified Hardware Coordination Conference:
 - a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.
- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.

- C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
- D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
- F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.06 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.07 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.
 - 1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
 - 2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.
 - a. Mechanical Warranty
 - 1) Locks: 10 years
 - 2) Exit Devices: 3 years
 - 3) Closers: 25 years
 - b. Electrical Warranty
 - 1) Locks & Exit Devices: 1 year

1.08 MAINTENANCE

- A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.
- B. Turn over unused materials to Owner for maintenance purposes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

DOOR HARDWARE

- A. Approval of manufacturers and/or products other than those listed as "Scheduled Manufacturer" in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.
- B. Approval of products is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.
- C. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

- A. Fabrication
 - 1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer's recognized installation standards for application intended.
 - 2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
 - 3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with "Metal Doors and Frames", "Flush Wood Doors", "Stile and Rail Wood Doors" to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.
- B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.
 - 1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.
- C. Cable and Connectors:
 - 1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.
 - 2. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.
 - 3. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.03 HINGES

- A. Manufacturers and Products:
 - 1. Scheduled Manufacturer and Product:
 - a. Ives 5BB series
- B. Requirements:
 - 1. Provide hinges conforming to ANSI/BHMA A156.1.
 - 2. Provide five knuckle, ball bearing hinges.
 - 3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:

DOOR HARDWARE

- a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
- b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
- 4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
 - a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
- 5. 2 inches or thicker doors:
 - a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
- 6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
- 7. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and
 - one additional hinge for each 30 inches (762 mm) of additional door height.
- 8. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 - a. Steel Hinges: Steel pins
 - b. Non-Ferrous Hinges: Stainless steel pins
 - c. Out-Swinging Exterior Doors: Non-removable pins
 - d. Out-Swinging Interior Lockable Doors: Non-removable pins
 - e. Interior Non-lockable Doors: Non-rising pins
- 9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

2.04 CYLINDRICAL LOCKS

- A. Manufacturers and Products:
 - 1. Scheduled Manufacturer and Product:
 - a. Schlage ND series
 - 2. Acceptable Manufacturers and Products:
 - a. Falcon T series
 - b. Arrow GL 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: Sparta (SPA).

2.05 EXIT DEVICES

- A. Manufacturers and Products:
 - 1. Scheduled Manufacturer and Product:
 - a. 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 grooved touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
- 4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
- 5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
- 6. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
- 7. Provide flush end caps for exit devices.
- 8. Provide exit devices with manufacturer's approved strikes.
- 9. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
- 10. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
- 11. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
- 12. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
- 13. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
- 14. Provide electrified options as scheduled.
- 15. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
- 16. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

2.06 CYLINDERS

- A. Manufacturers and Products:
 - 1. Scheduled Manufacturer and Product:
 - a. Schlage (or match City's existing keying system)
- B. Requirements:

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DOOR HARDWARE
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- 1. Provide cylinders/cores compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset; manufacturer's series as indicated. Refer to "KEYING" article, herein.
- 2. Provide cylinders in the below-listed configuration(s), distributed throughout the Project as indicated.
 - a. Conventional Patented Open: cylinder with permanent core with open keyway.
 - b. Conventional Patented Open: cylinder with interchangeable core with open keyway.
- 3. Patent Protection: Cylinders/cores requiring use of restricted, patented keys, patent protected.
- 4. Nickel silver bottom pins.

2.07 KEYING

- A. Scheduled System:
 - 1. New factory registered system:
 - a. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.
- B. Requirements:
 - 1. Construction Keying:
 - a. Replaceable Construction Cores.
 - 1) Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
 - a) 3 construction control keys
 - b) 12 construction change (day) keys.
 - 2) Owner or Owner's Representative will replace temporary construction cores with permanent cores.
 - 2. Permanent Keying:
 - a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
 - 1) Master Keying system as directed by the Owner.
 - b. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
 - c. Provide keys with the following features:
 - 1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
 - 2) Patent Protection: Keys and blanks protected by one or more utility patent(s).
 - 3) Geographically Exclusive: Where High Security or Security cylinders/cores are indicated, provide nationwide, geographically exclusive key system complying with the following restrictions.
 - d. Identification:
 - 1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
 - 2) Identification stamping provisions must be approved by the Architect and Owner.

- 3) Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
- 4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
- 5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
- e. Quantity: Furnish in the following quantities.
 - 1) Change (Day) Keys: 3 per cylinder/core.
 - 2) Permanent Control Keys: 3.
 - 3) Master Keys: 6.

2.08 KEY CONTROL SYSTEM

- A. Manufacturers:
 - 1. Scheduled Manufacturer:
 - a. Telkee
- B. Requirements:
 - 1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
 - a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
 - b. Provide hinged-panel type cabinet for wall mounting.

2.09 DOOR CLOSERS

- A. Manufacturers and Products:
 - 1. Scheduled Manufacturer and Product:
 - a. LCN 14050A and 1250A series
- B. Requirements:
 - 1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
 - 2. Provide door closers with fully hydraulic, full rack and pinion action with cast aluminum cylinder.
 - 3. Closer Body: 1-1/2-inch (38 mm) diameter with 11/16-inch (17 mm) diameter heat-treated pinion journal and full complement bearings.
 - 4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and all weather requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.

- 5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
- 6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and back check.
- 7. Pressure Relief Valve (PRV) Technology: Not permitted.
- 8. Provide stick on templates, special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.
- 2.10 DOOR TRIM
 - A. Manufacturers:
 - 1. Scheduled Manufacturer:
 - a. Ives
 - B. Requirements:
 - 1. Provide push plates, push bars, pull plates, pulls, and hands-free reversible door pulls with diameter and length as scheduled.

2.11 PROTECTION PLATES

- A. Manufacturers:
 - 1. Scheduled Manufacturer:
 - a. 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.
 - 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.

2.12 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

- A. Manufacturers:
 - 1. Scheduled Manufacturers:
 - a. 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.

DOOR HARDWARE

2.13 DOOR STOPS AND HOLDERS

- A. Manufacturers:
 - 1. Scheduled Manufacturer:
 - a. Ives
- B. Provide door stops at each door leaf:
 - 1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
 - 2. Where a wall stop cannot be used, provide universal floor stops.
 - 3. Where wall or floor stop cannot be used, provide overhead stop.
 - 4. Provide roller bumper where doors open into each other and overhead stop cannot be used.
- 2.14 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING
 - A. Manufacturers:
 - 1. Scheduled Manufacturer:
 - a. 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.

2.15 SILENCERS

- A. Manufacturers:
 - 1. Scheduled Manufacturer:
 - a. 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.

2.16 FINISHES

A. FINISH: As Scheduled.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Custom Steel Doors and Frames: HMMA 831.
 - 3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
 - 4. Installation Guide for Doors and Hardware: DHI TDH-007-20
- B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.
- C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.
- I. Lock Cylinders:
 - 1. Install construction cores to secure building and areas during construction period.
 - 2. Replace construction cores with permanent cores as indicated in keying section.
 - 3. Furnish permanent cores to Owner for installation.
- J. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:
 - 1. Conduit, junction boxes and wire pulls.

DOOR HARDWARE

- 2. Connections to and from power supplies to electrified hardware.
- 3. Connections to fire/smoke alarm system and smoke evacuation system.
- 4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
- 5. Connections to panel interface modules, controllers, and gateways.
- 6. Testing and labeling wires with Architect's opening number.
- K. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- L. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.
- M. Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
- N. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.
- O. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- P. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
- Q. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- R. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- S. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.03 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 - 2. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.04 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items per manufacturer's instructions to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.05 DOOR HARDWARE SCHEDULE

- A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.
- B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.
- C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.
- D. Hardware Sets:

HARDWARE SET # 001 (EXISTING)

For use on D	Door #(s):			
100E	103E 11	1E 117E		
EACH SGL	DOOR TO HAVE:			
<u>QTY</u>	DESCRIPTION	CATALOG NUMBER	<u>FINISH</u>	MFR
	ELECTROMAGNETIC LOCK	BY SECURITY CONTRACTOR	630	BYO
	CARD READER	BY SECURITY CONTRACTOR		BYO
	DOOR CONTACT	BY SECURITY CONTRACTOR		BYO
	POWER SUPPLY	BY SECURITY CONTRACTOR		BYO
	BALANCE OF HARDV	VARE REUSE EXISTING		

EXISTING STOREFRONT ENTRANCE DOORS, FRAMES AND HARDWARE TO REMAIN. SECURITY CONTRACTOR TO PROVIDE ALL OF THE NECESSARY HARDWARE AND ACCESSSORIES TO ADD ACCESS CONTROL TO THESE OPENINGS.

HARDWARE SET # 103

For use on Door #(s): 102A

EACH SGL DOOR TO HAVE:

<u>QTY</u>		DESCRIPTION	CATALOG NUMBER	<u>FINISH</u>	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND53TD SPA	626	SCH
1	EA	FSIC CORE	23-030 EV29 S	626	SCH
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE SET # 103A

For use on Door	#(s):
105	106

EACH SGL DOOR TO HAVE:

<u>QTY</u>		DESCRIPTION	CATALOG NUMBER	<u>FINISH</u>	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND53TD SPA	626	SCH
1	EA	FSIC CORE	23-030 EV29 S	626	SCH
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	SEALS	PERIMETER SEALS BY ALUM FRAME MFR		

THE HARDWARE SPECIFIED FOR THESE OPENINGS REQUIRES A 5" WIDE STYLE ALUMINUM STOREFRONT DOOR. THE DOOR MUST BE PREPARED FOR A GRADE 1 CYLINDRICAL LEVER SET.

HARDWARE SET # 201

For use on Door #(s): 114

EACH SGL DOOR TO HAVE:

<u>QTY</u>		DESCRIPTION	CATALOG NUMBER	<u>FINISH</u>	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ND80TD SPA	626	SCH
1	EA	FSIC CORE	23-030 EV29 S	626	SCH
1	EA	SURFACE CLOSER	1450 RW/PA FC	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE SET # 203

For use on Door #(s): 108 113

EACH SGL DOOR TO HAVE:

	DESCRIPTION	CATALOG NUMBER		<u>FINISH</u>	<u>MFR</u>
EA	HINGE	5BB1 4.5 X 4.5		652	IVE
EA	STOREROOM LOCK	ND80TD SPA		626	SCH
EA	FSIC CORE	23-030 EV29 S		626	SCH
EA	WALL STOP	WS406/407CCV		630	IVE
EA	SILENCER	SR64		GRY	IVE
	EA EA EA EA EA	DESCRIPTIONEAHINGEEASTOREROOM LOCKEAFSIC COREEAWALL STOPEASILENCER	DESCRIPTIONCATALOG NUMBEREAHINGE5BB1 4.5 X 4.5EASTOREROOM LOCKND80TD SPAEAFSIC CORE23-030 EV29 SEAWALL STOPWS406/407CCVEASILENCERSR64	DESCRIPTIONCATALOG NUMBEREAHINGE5BB1 4.5 X 4.5Image: Comparison of the comparison of t	DESCRIPTIONCATALOG NUMBERFINISHEAHINGE5BB1 4.5 X 4.5652EASTOREROOM LOCKND80TD SPA626EAFSIC CORE23-030 EV29 S626EAWALL STOPWS406/407CCV630EASILENCERSR64GRY

HARDWARE SET # 301

For use on Door #(s): 104

<u>QTY</u>		DESCRIPTION	CATALOG NUMBER	<u>FINISH</u>	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK	ND40S SPA	626	SCH
1	EA	SURFACE CLOSER	1250 RW/PA FC	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE SET # 301I

116

For use on Door #(s):

115

EACH	SGL DO	OR TO HAVE:			
QTY		DESCRIPTION	CATALOG NUMBER	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK	ND40S SPA OS-OCC (INDICATOR PRIVACY)	626	SCH
1	EA	SURFACE CLOSER	1450 RW/PA FC	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE SET # C201

EACH SGL DOOR TO HAVE:

For use on Door #(s):				
107	111	117		

<u>QTY</u>		DESCRIPTION	CATALOG NUMBER	<u>FINISH</u>	MFR
2	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 TW8	652	IVE
1	EA	STOREROOM LOCK	ND80TDEU SPA RX	626	SCH
1	EA	FSIC CORE	23-030 EV29 S	626	SCH
1	EA	SURFACE CLOSER	1450 RW/PA FC	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE
		CARD READER	BY SECURITY CONTRACTOR		BYO
		DOOR CONTACT	BY SECURITY CONTRACTOR		BYO
		POWER SUPPLY	BY SECURITY CONTRACTOR		BYO

OUTSIDE LEVER IS NORMALLY LOCKED. PRESENTING A VALID CREDENTIAL TO THE CARD READER WILL TEMPORARILY RELEASE THE GATE ON THE ELECTRIC STRIKE PROVIDING ACCESS TO THE ROOM. INSIDE LEVER IS ALWAYS UNLOCKED PROVIDING FREE EGRESS AT ALL TIMES.

HARDWARE SET # C201A

For use	e on Do	or #(s):			
102		103			
EACH	SGL DO	OOR TO HAVE:			
<u>QTY</u>		DESCRIPTION	CATALOG NUMBER	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 TW8	630	VD
1	EA	STOREROOM LOCK	ND80TDEU SPA RX	626	SCH
1	EA	FSIC CORE	23-030 EV29 S	626	SCH
1	EA	SURFACE CLOSER	1450 RW/PA FC	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	SEALS	PERIMETER SEALS BY ALUM		
			FRAME MFR		
		CARD READER	BY SECURITY CONTRACTOR		BYO
		DOOR CONTACT	BY SECURITY CONTRACTOR		BYO
		POWER SUPPLY	BY SECURITY CONTRACTOR		BYO

THE HARDWARE SPECIFIED FOR THESE OPENINGS REQUIRES A 5" WIDE STYLE ALUMINUM STOREFRONT DOOR. THE DOOR MUST BE PREPARED FOR A GRADE 1 CYLINDRICAL LEVER SET.

OUTSIDE LEVER IS NORMALLY LOCKED. PRESENTING A VALID CREDENTIAL TO THE CARD READER WILL TEMPORARILY RELEASE THE GATE ON THE ELECTRIC STRIKE PROVIDING ACCESS TO THE ROOM. INSIDE LEVER IS ALWAYS UNLOCKED PROVIDING FREE EGRESS AT ALL TIMES.

END OF SECTION

SECTION 08 81 00 — GLASS AND GLAZING

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 WORK INCLUDED

- A. Glazing for hollow metal doors and frames.
- B. Glazing for aluminum frames.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Hollow metal doors and frames.
- B. Aluminum entrances and storefronts.
- C. Aluminum window systems.

1.4 SUBMITTALS

- A. Submit manufacturer's literature with material and performance descriptions for each type of glass, sealant and glazing accessories.
- B. Submit detailed shop drawings indicating locations, installation and sealing methods.
- C. Submit 12" x 12" physical samples of each type of tinted or wire glass and panel.
- D. Obtain approved shop drawings from hollow metal supplier, aluminum frame supplier, plastic laminate door supplier.
- E. Reference Section 01 33 00 SUBMITTALS for additional submittal requirements.
- 1.5 WARRANTY

- A. Provide written warranty against defects in materials and workmanship for the work under this section for a period of one year after the date of Substantial Completion of the project.
- B. Warranted defects shall include but not necessarily be limited to water infiltration, air infiltration, glass failure due to improper sizing or installation, sealant failure.

1.6 QUALITY ASSURANCE

- A. Glazing contractor shall have a minimum of 3 years experience in the installation of glazing products for projects of similar size and scope as this project.
- B. Each piece of glass shall bear manufacturer's label indicating type.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Do not deliver glass or panels to the jobsite until openings are ready for glazing.
- B. Deliver glass and panels in manufacturer's original protective packaging. Store in a dry, well ventilated area and take care to prevent condensation on the materials. Keep glass faces separated.

1.8 MINIMUM COMPLIANCE STANDARDS

- A. SAFETY: Contractor shall be responsible for meeting all Federal and applicable code requirements for types and locations of glazing regardless of drawing indications. Comply with the current standards of the Consumer Products Safety Commission and Federal Standard 16 CFR 1201 Federal Architectural Glazing Materials Safety Standard.
- B. INSTALLATION: Comply with recommendations of Flat Glass Marketing Association FGMA Glazing Manual.

PART 2 - PRODUCTS

2.1 GENERAL

- A. GLAZING SHEETS: Glazing materials shall conform to the highest qualities as specified in the following standards:
 - 1. Float glass: FS DD-G-451d and ASTM C1036.
 - 2. Float glass, heat strengthened: ASTM C1036 and ASTM C1048.
 - 3. Float glass, tempered: FS DD-G-1403B and ASTM C1036, ASTM C1048, ANSI Z97.1, and Consumer Product Safety Commission 16 CFR 1201.
 - 4. Wired glass: FS DD-G-451, ASTM C1036 and ANSI Z97.1. Misco diamond pattern.
 - 5. Insulating glass: ASTM C1036. Meet industry standards set by the Sealed Insulating Glass Manufacturers Association (SIGMA).
- B. MISCELLANEOUS
 - 1. Glazing sealants: FS TT-S-1543A (silicone rubber); FS TT-S-230 (synthetic rubber); FS TT-S-001657 (butyl rubber).
 - 2. Glazing tape: Architectural Aluminum Manufacturer's Association.

2.2 MANUFACTURERS

- A. GLASS:
 - 1. Guardian
 - 2. PPG Industries
 - 3. Pilkington.

B. TEMPERING, LAMINATING AND HEAT STRENGTHENING:

- 1. Oldcastle
- 2. Trulite
- C. WIRE GLASS:
 - 1. Pilkington
 - 2. PPG Industries
- D. GLAZING TAPE:
 - 1. TREMCO tape, shims, setting blocks, edge blocking.
- E. GLAZING SEALANT:
 - 1. TREMCO,
 - 2. General Electric.
- 2.3 MATERIALS: Types as indicated in the drawings.
 - A. TEMPERED GLASS: 1/4" clear and solar tint float glass tempered by the vertical or horizontal process and meeting requirements of FS DD-G-1403B.
 - B. WIRE GLASS: Shall be 1/4" thick. Polish plate glass reinforced with diamond pattern wire mesh No. 24 gauge minimum, with a mesh not larger than 1".
 - C. HOLLOW METAL FRAME AND DOOR GLAZING SYSTEM:
 - 1. Glazing: 1/4" Tempered.
 - 2. Glazing tape: 1/8" x 3/8" x continuous preshimmed butyl tape; Tremco 440.
 - 3. Setting blocks: Neoprene or EPDM in minimum 4" lengths.
 - 4. Edge blocking: Neoprene or EPDM in minimum 4" lengths and sized to allow for 1/8" clear expansion at both vertical edges.
 - 5. Add sealant at exterior glazing.

2.4 INSULATING GLASS

- A. Solar Control Tinted Insulated Units
 - 1. Conformance: ASTM C 1172 and complying with testing requirements in CPSC 16CFR-1201 for Category II materials.
 - 2. Overall Thickness: 1 inch (25 mm)
 - 3. Outboard Lite: Bronze float glass.
 - a. Tinted Float Glass: ASTM C 1036, Type I, Class 2, Quality q3.
 - b. Glass Thickness: 1/4 inch (6 mm).
 - c. Heat Treatment: Fully Tempered, ASTM C 1048, Kind FT
 - 4. Interspace: ¹/₂ inch (12 mm) hermetically sealed air
 - 5. Inboard Lite: Clear float glass.
 - a. Clear Float Glass: ASTM C 1036, Type I, Class 1, Quality q3.
 - b. Glass Thickness: 1/4 inch (6 mm).
 - c. Heat Treatment: Fully Tempered, ASTM C 1048, Kind FT
 - 6. Sealant: Approved by glass manufacturer.

7. Nominal shading coefficient: 0.53

PART 3 - EXECUTION

3.1 INSTALLATION

A. GENERAL: Install glass without warping, binding or stress. Allow for expansion and contraction of glass due to temperature changes. Do not install sealant with surfaces or ambient temperature below 40 degrees F.

B. HOLOW METAL FRAMES AND DOORS:

- 1. Ensure that finish painting of doors and frames is complete.
- 2. Cut glazing tape to length and install against permanent stop, flush with face of stop.
- 3. Place setting blocks at 1/4 points.
- 4. Rest glass on setting blocks and press against stop for full contact and adhesion at perimeter.
- 5. Place continuous glazing tape on opposite-face perimeter of glass in same manner described above. Install removable stop; avoid displacement of tape; and exert pressure on tape for full continuous contact.
- 6. Knife trim excess of protruding tape (leave recessed for sealant at exterior glazing).
- 7. Do not touch glass to metal.
- C. PLASTIC LAMINATE DOORS:
 - 1. Follow procedures specified above for non-rated doors. Metal stops provided by door manufacturer.
 - 2. Follow recommendations of door manufacturer for rated doors. Metal stops provided by door manufacturer.
- D. ALUMINUM FRAMES: Follow door and frame manufacturer's printed instructions for glazing gasketed systems. Provide watertight installation at exterior systems.

3.2 CLEANING AND PROTECTION

- A. During glazing operations, provide sufficient stick-on safety labels or hang streamers on new glazing.
- B. Prior to project closeout, thoroughly clean all glazing inside and out with commercial glass cleaner.
- C. Reglaze any openings where glass is chipped, broken, scratched, pitted or stained.

END OF SECTION

SECTION 09 30 00 — WALL AND FLOOR TILE

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 WORK INCLUDED

- A. Provide and install all ceramic wall and floor tile and base as indicated in the drawings and specified herein.
- B. Provide and install all quarry tile flooring and base as indicated in the drawings and specified herein.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Cast-in-place concrete.
- B. Drywall systems.
- C. Masonry.
- D. Waterproofing and dampproofing.

1.4 SUBMITTALS

- A. Per SUPPLEMENTARY GENERAL CONDITIONS, submit samples, type of tile and color for Architect's approval. Mark with manufacturer's name and space where tile is to be installed.
- B. Submit manufacturer's printed literature describing products.
- C. Submit (2) boxes of tile chips showing full range of available colors.
- D. Submit (2) boxes of grout color samples.
- E. Submit 12" x 12" grouted sample board for each tile/grout combination selected.

F. Reference Section 01 33 00 SUBMITTALS for additional submittal requirements.

1.5 WARRANTY

- A. Provide written warranty against defects in materials and workmanship for the work under this section for a period of one year after the date of Substantial Completion of the project.
- B. Warranted defects shall include but not necessarily be limited to cracking, crazing, staining, joint spalling or cracking, loosening of bond.

1.6 QUALITY ASSURANCE

- A. Tile Contractor shall have a minimum of 3 years experience in tile installation for projects of similar size and scope as this project.
- B. Conform with all applicable requirements of the American Standards Association Specifications (A-108 Series) and the "Tile Handbook" of the Tile Council of America. Tile shall bear the seal of Tile Council of America, Inc., and be equal to or exceed Standard Grade.

1.7 DELIVERY & STORAGE

- A. Deliver all manufactured materials in original, unbroken containers bearing name of manufacturer, brand and grade seal. Keep materials dry, clean and protected against deterioration in any form and at room temperature.
- B. Maintain room temperature between 70 and 80 degrees F. 24 hours prior, during and a minimum of 48 hours after installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. CERAMIC TILE:
 - 1. American Olean
 - 2. Dal-Tile
 - 3. United States Ceramic Tile Co.
- B. QUARRY TILE: American Olean, United States Ceramic Tile Co.
- C. GROUT:
 - 1. American Olean
 - 2. Laticrete
 - 3. Tex Rite

2.2 MATERIALS

- A. GENERAL:
 - 1. <u>Floor Tile:</u> Unglazed porcelain ceramic with cushioned edges and sheet backing.
 - a. <u>Water absorption</u>: Classified "Impervious" per A.S.T.M. C-373. Less than 1/2 of 1% absorption.
 - b. <u>Size:</u> Nominal 12" x 12" x 1/4" thick.
 - c. <u>Base:</u> 4" high base. Bottom tile with integral cove (provide bullnose plastic edge strip at top of all ceramic tile base).
 - d. <u>Type:</u> Porcelain Tile in *groups 3 through 4* as selected by the Architect from one of the specified manufacturers.
 - e. <u>Color(s)</u>: Bidders shall assume a different color scheme for each room unless colors and patterns are indicated in the drawings.
- B. TOILET/SHOWER ROOMS:
 - 1. <u>Floor Tile:</u> Unglazed porcelain ceramic with cushioned edges and sheet backing.
 - a. <u>Water absorption:</u> Classified "Impervious" per A.S.T.M. C-373. Less than 1/2 of 1% absorption.
 - b. <u>Size:</u> Nominal 1" x 1" x 1/4" thick.
 - c. <u>Base:</u> 4" high base. Bottom tile with integral cove.
 - d. <u>Type:</u> Porcelain Tile in *groups 1 through 2* as selected by the Architect from one of the specified manufacturers.
 - e. <u>Color(s)</u>: Bidders shall assume a different color scheme for each room unless colors and patterns are indicated in the drawings.
 - 2. <u>Wall Tile:</u> Glazed ceramic with cushion edges.
 - a. <u>Size:</u> Nominal 4" x 4" x 1/4" thick.
 - b. <u>Base:</u> See floor base.
 - c. <u>Type:</u> *Groups 3 through 4* for field tile and for accent banding as selected by the Architect from one of the specified manufacturers.
 - d. <u>Color(s)</u>: Bidders shall assume a different color scheme for each room unless colors and patterns are indicated in the drawings.
 - 3. <u>Trim:</u> Terminate tile with bullnose edges and rounded outside corners. Provide square inside corners and at ceiling/wall joints.
- C. THINSET BOND COAT: Latex/Portland Cement mortar mix meeting requirements of ANSI A118.4. Provide Portland cement and sand in a 1 to 1 mixture gauged with Laticrete 4237 latex additive. Use on dry cured mortar bed at slab recesses, where thinset on concrete slab, and where thinset on wall substrates.
- D. SEALANT: One part silicone rubber meeting requirements of FS TT-S-001543, as manufactured by Dow Corning or General Electric.
- E. GROUT:
 - 1. <u>Walls:</u> Portland Cement waterproof, dry set grout as manufactured by American Olean. Color(s) as selected by Architect.
 - 2. <u>Floor and base:</u> Interior grout shall be epoxy type as manufactured by American Olean. Color(s) as selected by Architect.
- F. SEALANT: One part silicone rubber meeting requirements of FS TT-S-001543, as manufactured by Dow Corning or General Electric.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION

- A. Examine surfaces to receive tile and do not start work until defects that will adversely affect tile work have been corrected.
- B. Inspect all surfaces to see that they are dry, clean, free of oily or waxy film, firm, level and plumb. Report any unsatisfactory conditions to the Architect. Starting installation shall be deemed as acceptance of surfaces.
- C. Do not start until work of other trades, which goes through or in the space behind tile has been completed. Do not proceed with installation until adjoining work is satisfactory protected. Close off spaces in which tile is being set to traffic and other work during installation and for at least 48 hours after completion of tile work.
- D. Do not apply mortar and adhesives to surfaces covered by frost. Maintain minimum temperature-for installation of tile above 50 Deg. F. Prevent rapid evaporation of moisture from mortar bed. Do not set tile on dry bed.
- E. Install specified mortar bed at slab depressions. Slope mortar bed uniformly to drain(s).

3.2 INSTALLATION

- A. GENERAL: Tile shall be installed in accordance with current Tile Council of America's "Handbook for Ceramic Tile Installation", design numbers as indicated below.
- B. Center fields and patterns on applied areas so that no tile is less than half size. For heights stated in feet and inches, maintain full courses to nearest attainable height without cutting tile.
- C. Except where otherwise shown or specified, make joints in wall tile vertical and horizontal and joints in floor tile perpendicular and parallel to walls. Control joint widths of glazed tile by lugs on the sides of tile. Control joints widths between sheets of ceramic mosaic tile by supporting boards with metal spacing strips.
- D. Grind and fit tile carefully at intersections, against trim finish and at built-in fixtures and accessories. Fit tile closely around outlets, pipes, fixtures and fittings so that plates, escutcheons and collars will overlap cuts. Cut and drill tile and trim shapes accurately without damage. Rub all exposed cut edges smooth with abrasive stone.
- E. Coat trim with 1/32 to 1/16" pure coat paste. Set in same mortar mix as is recommended for setting flat tile on walls. Do not use pure coat as mortar to set trim and angles.

F. FLOORS:

- 1. <u>Interior thinset on concrete floor slab:</u>
 - a. Tile bonded with minimum 3/32" thick latex-Portland cement bond coat over cleavage membrane adhered to floor slab (modified TCA F113).
 - b. Adhere cleavage membrane to slabin strict accordance with manufacturer's recommendations using specified latex-Portland cement bond coat. Increase typical curing time of bond coat by 50%.
- 2. <u>Interior thin-set on recessed mortar bed (where required at existing kitchens)</u>: Tile bonded with minimum 3/32" thick Latex-Portland Cement bond coat to reinforced mortar bed over loose bond breaker membrane over floor slab (TCA F111).

G. WALLS:

- 1. <u>Ceramic Tile at Drywall Toilets:</u> Thinset to water resistant gypsum wallboard.
- 2. <u>Ceramic Tile at Drywall Showers:</u> Thinset to tile backer board.
- 3. <u>Ceramic Tile at Masonry:</u> Bonded to mortar bed at masonry. No. W211.
- 4. <u>12" x 12" Porcelain Up to 3 ft. High Wainscot:</u> Install with mastic over drywall.
- 5. <u>12" x 12" Porcelain Over 3 ft. High Wainscot:</u> Thinset over tile backer board.

H. EXPANSION JOINTS:

- 1. At floor tile provide 1/4" sealant expansion joints in accordance with TCA recommendations where tile abuts walls, curbs, columns and other restraining surfaces, where substrate material changes, at floor slab construction joints (cold joints), and each way in pattern approved by the Owner.
- 2. At walls install sealant expansion joints at inside corners, at maximum 30', and at other conditions subject to cracking or movement. Install specified sealant at expansion and control joints, at doorframe perimeters and similar conditions.

3.3 LAYOUT

- A. Layout all work so that no tiles less than half size occur. Align all joints vertically and horizontally.
- B. Cut and drill neatly without marring tile. Rub smooth any necessary cuts with a fine stone and set no cut edge against any fixture, cabinet, or other tile without a joint at least 1/16" wide.
- C. Maximum plane variation shall be 1/8" + or in 10' when a straight edge is laid on the surface in any direction.

3.4 GROUTING AND SEALING:

- A. Follow grout manufacturer's recommendations for grouting procedures and precautions. Damp cure nonepoxy grout in accordance with manufacturer's recommendations.
- B. Grout Haze Removal:
 - 1. Unglazed Tile: For cement grout remove all grout haze following grout manufacturer's recommendations for use of acid and chemical cleaners. Rinse tilework thoroughly with clean water before and after chemical cleaners. Polish surface of tilework with soft cheesecloth.
 - 2. Glazed Tile: For cement grout remove all grout haze with cheesecloth rub.
 - 3. Take special care with epoxy grout to keep tiles clean as work progresses.

3.5 **PROTECTION**

- A. Protect tiled floors from foot and wheel traffic for at least 7 days after installation.
- B. Place plywood panels over traffic floors.
- C. In non-traffic areas, cover floors with heavy paper taped in place.
- D. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Furnish quantity not less than 5 percent for each color, pattern, and type of tile installed.

END OF SECTION

SECTION 09 50 00

09 54 46 FELTWORKS[™] Blades (Ebbs & Flows) Acoustical Panels

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- a) Section Includes:
 - 1. Non-Woven layered and formed Polyester felt fiber ceiling panels
 - 2. Wire hangers, fasteners, main runners, cross tees, wall angle moldings and accessories.

b) Related Sections:

- 1. Section 09 53 00 Acoustical Ceiling Suspension Assembly
- 2. Section 09 20 00 Plaster and Gypsum Board
- 3. Section 09 22 16 Non-Structural Metal Framing
- 4. Section 01 81 13 Sustainable Design Requirements
- 5. Section 01 81 19 Indoor Air Quality Requirements
- 6. Divisions 23 (15) HVAC
- 7. Division 26 (16) Sections Electrical Work
- c) Alternates
 - 1. Prior Approval: Unless otherwise provided for in the Contract documents, submit proposed product substitutions no later than TEN (10) working days prior to the date established for receipt of bids. Acceptability of a proposed substitution is contingent upon the Architect's review and acceptance. Approved products will be set forth by the Addenda. If a substitution is included in a Bid and is not approved by an Addendum, the specified products shall be provided as in place of the substitute without additional compensation.
 - 2. Submittals, which do not provide adequate data for the product evaluation, will not be considered. The proposed substitution must meet all requirements of this section, including but not necessarily limited to, the following: Single source materials suppliers (if specified in Section 1.5); panel design, size, composition, color, and finish; suspension system component profiles and sizes; compliance with the referenced standards.

1.3 REFERENCES

- a) American Society for Testing and Materials (ASTM):
 - 1. ASTM D3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber

FELTWORKS BLADES ACOUSTICAL PANELS 8/9/2024

- 2. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
- 3. ASTM E580 Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Seismic Restraint.
- 4. ASTM C423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
- 5. ASTM E795 Standard Practices for Mounting Test Specimens During Sound Absorption Tests
- 6. International Building Code
- 7. ASHRAE Standard 62 1 2004 Ventilation for Acceptable Indoor Air Quality
- 8. California Department of Public Health CDPH/EHLB Emission Standard Method Version 1.2 2017
- 9. California Green Building Standards Code Cal Green Title 24
- 10. NFPA 70 National Electrical Code
- 11. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures
- 12. International Code Council-Evaluation Services AC 156 Acceptance Criteria for Seismic Qualification Testing of Non-structural Components
- 13. LEED Leadership in Energy and Environmental Design is a set of rating systems for the design, construction, operation, and maintenance of green buildings
- 14. Underwriters Laboratories Green Guard
- 15. International Living Building Challenge

1.4 SUBMITTALS

- a) **Shop Drawings**: Provide layout including panel type and components used in the assembly of the ceiling. Show locations of items that are to be coordinated with the ceiling.
- b) **Installation Instructions**: Submit manufacturer's installation instructions as referenced in Part three, Installation.
- c) **Samples:** Minimum 6 inch x 6 inch sample of the colors selected in the ceiling design, include manufacturer sample of suspension components.
- d) **Product Data:** Submit manufacturer's technical data for each type of ceiling unit and suspension system required.
- e) **Certifications:** Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards.
- f) Non-Conformance: All products not conforming to the requirements of this specification and or the manufacturer's published values are to be disposed. The Contractor performing the work will replace with approved product at their expense.

1.5 QUALITY ASSURANCE

a) Single-Source Responsibility: Provide ceiling panel units and suspension components by a single manufacturer.

FELTWORKS BLADES ACOUSTICAL PANELS 8/9/2024
- b) Fire Performance Characteristics: Identify ceiling components with appropriate markings of applicable testing and inspecting organization.
 - 1. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with Class A products.
 - i. Flame Spread: 25 or less
 - ii. Smoke Developed: 450 or less
- c) Fire Sprinklers: Ceiling systems may obstruct or Skew the planned water distribution pattern of fire sprinkler. In addition to creating a possible delaying or accelerating the activation of the sprinkler of fire detection system. Consult with a fire protection engineer for guidance.
- d) Coordination of Work: Coordinate ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.6 DELIVERY, STORAGE, AND HANDLING

- a) Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- b) Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.
- c) White gloves recommended for handling to avoid marring, especially on light color panels.

1.7 PROJECT CONDITIONS

- a) Space Enclosure:
 - I. HumiGuard Plus Ceilings: Building areas to receive ceilings shall be free of construction dust and debris. Products with HumiGuard Plus performance and hot dipped galvanized steel suspension systems can be installed up to 120°F (49°C) and in spaces before the building is enclosed, where HVAC systems are cycled or not operating. Cannot be used in exterior applications where standing water is present or where moisture will come in direct contact with the ceiling.

1.8 WARRANTY

- a) Acoustical Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period.
- b) Warranty Period:
 - I. Acoustical panels and Suspension: One (1) year from date of substantial completion
- c) The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

FELTWORKS BLADES ACOUSTICAL PANELS 8/9/2024

1.9 SUSTAINABLE MATERIALS

- a) The GREENGUARD Certification Program gives assurance that products designed for use in indoor spaces meet strict chemical emissions limits, which contribute to the creation of healthier interiors. GREENGUARD Certified products meet stringent chemical emissions requirements, such as being screened for more than 10,000 volatile organic compounds (VOCs).
- b) Health Product Declaration. The end use product has a published, complete Health Product Declaration with disclosure at a minimum of 1000ppm of known hazards in compliance with the Health Product Declaration open Standard.
- c) Declare Label. The end use product has a published Declare label by the International Living Future Institute with disclosure of 100 ppm with a designation of Red List Free or Compliant (less than 1% proprietary ingredients).
- d) Low Emitting products with VOC emissions data. Preference will also be given to manufacturers that can provide emissions data showing their products meet CDHP Standard Method v1.2 (Section 01350).
- e) Life cycle analysis. Products that have communicated lifecycle data through Environmental Product Declarations (EPDs) will be preferred.
- f) Products meeting LEED V4 requirements.

1.10 MAINTENANCE

- a) Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.
 - 1. Ceiling Units: Furnish quality of full-size units equal to 2.0 percent of amount installed.
 - 2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 1.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- a) Basis of Design FELTWORKS Blades:
 - 1. Armstrong World Industries, Inc.
- b) Suspension Systems:
 - 1. Armstrong World Industries, Inc.

2.2.0 CEILING UNITS

- a) Ceiling Panel:
 - 1. Surface Texture: Soft
 - 2. Composition: Non-woven layered and formed Polyester felt (PET) fiber
 - 3. Color: Cotton
 - 4. Edge Profile: Square

FELTWORKS BLADES ACOUSTICAL PANELS 8/9/2024

- 5. Light Reflectance (LR) Cotton Panel: ASTM E 1477; 0.80
- 6. Material Ingredient Transparency: Health Product Declaration (HPD); Declare Label
- 7. Green Guard Gold Certified
- 8. Sizes (Select appropriate panel size):
 - i. 6533KEF0001___96" Ebbs & Flows Blades Kit Includes 6 unique shapes -4 of each - 24 pcs per kit Varies x 96" x 3/8
 - ii. 6533KEF0002___48" Ebbs & Flows Blades Kit Includes 12 unique shapes 2 of each 24 pcs per kit Varies x 48" x 3/8"
 - iii. Customer Blades Rectangular Vertical Hook Custom Blades Available
 - 1. Length 28"-96"
 - 2. Depth 5"-16"
- 9. Acoustical Performance is tested per ASTM C423 and mounted in accordance with ASTM E795. NRC of 0.85 based on E-400 mounting*
- 10. Flame Spread: Class A
- 11. Dimensional Stability: HumiGuard Plus.
- 12. Acceptable Product: FELTWORKS Blades Ebbs & Flows as manufactured by Armstrong World Industries.

2.2.1 SUSPENSION SYSTEMS

a) Armstrong Aluminum Suspension System:

- 1. Acceptable Product: Listed Below as manufactured by Armstrong World Industries, Inc. Items are available in custom colors; contact ASQuote@armstrongceilings.com.
 - i. Item 8230 96" Suspension Bar for 3/8" FeltWorks Blades connector holes on both ends
 - ii. Item 6651AB 96" Suspension Bar End-to-End Connectors
 - iii. Item 6655 Blades Hanging Kit Each kit includes 4 hanging assemblies, use on kit for each suspension

PART 3 - EXECUTION

3.1 EXAMINATION

- a) Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out.
- b) Proper designs for both supply air and return air, maintenance of the HVAC filters and building interior space are essential to minimize soiling. Before starting the HVAC system, make sure supply air is properly filtered and the building interior is free of construction dust.

3.2 PREPARATION

a) Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.

3.3 INSTALLATION

FELTWORKS BLADES ACOUSTICAL PANELS 8/9/2024

a) Install suspension system and blades in compliance with the approval of the authorities having jurisdiction, and in accordance with the manufacturer's FELTWORKS Blades Installation Instructions.

3.4 ADJUSTING AND CLEANING

- a) Replace damaged and broken panels.
- b) Clean exposed surfaces of ceilings panels, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage.

SECTION 09 50 00

SoundScapes[®] Shapes Acoustical Clouds – Colors

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Acoustical ceiling and wall panels
 - 2. Exposed grouping frame suspension systems
 - 3. Wire hangers, cables, fasteners, wall and ceiling hanging kit accessories
- B. Related Sections:
 - 1. Section 09 51 00 Acoustical Ceilings
 - 2. Section 09 53 00 Acoustical Ceiling Suspension Assemblies
 - 3. Section 09 54 33 Decorative Panel Ceilings
 - 4. Section 09 20 00 Gypsum Board
 - 5. Division 23 HVAC Air Distribution Mechanical Work Division
 - 6. Division 26 Electrical Work
- C. Alternates
 - 1. Prior Approval: Unless otherwise provided for in the Contract documents, proposed product substitutions may be submitted no later than TEN (10) working days prior to the date established for receipt of bids. Acceptability of a proposed substitution is contingent upon the Architect's review of the proposal for acceptability and approved products will be set forth by the Addenda. If included in a Bid are substitute products which have not been approved by Addenda, the specified products shall be provided without additional compensation.
 - 2. Submittals which do not provide adequate data for the product evaluation will not be considered. The proposed substitution must meet all requirements of this section, including but not necessarily limited to, the following: Single source materials suppliers (if specified in Section 1.5); Underwriters' Laboratories Classified Acoustical performance; Panel design, size, composition, color, and finish; Suspension system component profiles and sizes; Compliance with the referenced standards.

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
 - 2. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
 - 3. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
 - 4. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
 - 5. ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
 - 6. ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels
 - 7. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials

- 8. ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
- 9. ASTM E 580 Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions
- B. NFPA 286 Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth
- C. ASHRAE Standard 62.1-2004, "Ventilation for Acceptable Indoor Air Quality"
- D. ICC ESR 1308 International Code Council Evaluation Report Independent Evaluation of Armstrong Suspension Components for Seismic Installations
- E. International Building Code
- F. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures
- G. International Code Council-Evaluation Services AC 156 Acceptance Criteria for Seismic Qualification Testing of Non-structural Components
- H. LEED Leadership in Energy and Environmental Design is a set of rating systems for the design, construction, operation, and maintenance of green buildings

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's <u>technical data</u> for each type of acoustical ceiling unit and suspension system required.
- B. Samples: Minimum <u>6" x 6" submittal sample</u> of specified panel color.
- C. Shop Drawings: Layout and details of acoustical ceilings show locations of items, which are to be coordinated with, or supported by the ceilings.
- D. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards.

1.5 QUALITY ASSURANCE

- A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.
- B. Fire Performance Characteristics: Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.
 - 1. Surface Burning Characteristics: Class A as follows, tested per ASTM E84 and CAN/ULC S102:
 - a. Flame Spread: 25 or less
 - b. Smoke Developed: 50 or less
- C. Handle acoustical panels carefully to avoid scratching or denting units in any way.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.

1.7 PROJECT CONDITIONS

A. Space Enclosure:

All ceiling products and suspension systems must be installed and maintained in accordance with Armstrong written installation instructions for that product in effect at the time of installation and best industry practice. Prior to installation, the ceiling product must be kept clean and dry, in an environment that is between 32°F (0°C) and 120°F (49°C) and not subject to Abnormal Conditions. Abnormal

8/9/2024

conditions include exposure to chemical fumes, vibrations, moisture from conditions such as building leaks or condensation, excessive humidity, or excessive dirt or dust buildup.

1.8 WARRANTY

- A. Shapes: Submit a written warranty executed by the manufacturer, agreeing to repair or replace acoustical panels that fail within the warranty period. Failures include, but are not limited to:
 - 1. Shape Panels: Sagging and warping as a result of defects in materials or factory workmanship.
 - 2. Suspension System: Rusting and manufacturer's defects
- B. Warranty Period:
 - 1. Shapes: One (1) year from date of substantial completion
 - 2. Suspension System: Ten (10) years from date of substantial completion
- C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.9 MAINTENANCE

- A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.
 - 1. Acoustical Ceiling Units: Furnish quality of full-size units equal to 5.0 percent of amount installed.
 - 2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 2.0 percent of amount installed.

Part 2-PRODUCTS

2.1 MANUFACTURERS

2.2. LINEAR CEILING UNITS

- Basis of Design SoundScapes Shapes

 a) Armstrong World Industries Inc.
- 2) Suspension System
 - a) Armstrong World Industries Inc.

2.2.1 SoundScapes Shapes:

- 1. Surface Texture: Fine
- 2. Composition: Fiberglass
- Color: White (DWH), Black (DBL), Riverstone (DRV), Stone (DSE), Oat (DOT), Light Grey (DLG), Sandstone (DSS), Boxwood (DBW), Fern (DFN), Ivy (DIV), Ocean (DOC), Twilight (DTT), Rainstorm (DRS), Mist (DMT), Topaz (DTZ) or custom color
- Shape Design: 7101F02P01 60° Parallelogram 7101F02T01 60° Triangle 7101F02Z01 60° Trapezoid
- 5. Edge Profile: Square
- 6. Recycled Content: 51%
- 7. Acoustics: Sound absorption up to 1.00 NRC
- 8. Flame Spread: ASTM E 1264; Class A (UL)
- 9. Dimensional Stability: BioBlock; Anti-Microbial, inherent

10. Acceptable Product: SoundScapes Shapes, (7101F02P01, 7101F02T01, 7101F02Z01) as manufactured by Armstrong World Industries

2.2.2 Individual Suspension:

- 1. Cable Suspension: Acceptable product as manufactured by Armstrong World Industries
 - a. Item 5450L8CR Deck Hanging Kit (2 per kit). Allows for suspending individual shapes or grouping frames from deck and bottom end adjustment of height at panel or frame level.
 - b. Item 625530 Extended Hanging Aircraft Cables (30' length, 4 per bag). For use with Item 6655 when longer cables are needed.
 - c. Item 7121 Angled Hanging Kit (2 per kit). 60° maximum angle.
 - d. Item 7006 Escutcheon Kit (2 per kit). Used when hanging panels below an existing ceiling.

2.2.3 Individual Mounting:

- 1. Attachment to Drywall or solid surface: Acceptable product as manufactured by Armstrong World Industries
 - a. Item 5455 Drywall Hanging Kit (2 per kit) For individual panel attachment to structure.
 - b. Item 5588 Wall Hanging Kit (4 per kit) For individual panel attachment to a wall.

2.2.4 Group Suspension Systems:

- A. Group Suspension: Acceptable product as manufactured by Armstrong World Industries
 - a. Item 5451__- Grouping Frame Kit, Black or White (4 per kit). 12' suspension frames used to group panels together.
 - b. Item 5452__- Frame Splice Kit, Black or White (2 per kit). Connects group suspension frames for longer runs (> 12 feet).
 - c. Item 5453D060 60° Frame Alignment Kit (4 per kit). For use with group suspension frames.
 - d. Item 5453D090 90° Frame Alignment Kit (4 per kit). For use with group suspension frames.
 - e. Item 5454__ Panel Hook Kit, Black or White. For use with group frames (one kit per all panels except item 5449, Large Rectangle, which requires two kits).
 - f. Item 5450L8CR Deck Hanging Kit (2 per kit). Allows for suspending grouping frames from deck and bottom end adjustment of height at panel or frame level.
- B. Accessories
 - a. Item 5632 Grid Hook Kit (4 per kit). For hanging individual panels from an Armstrong standard suspension system.
 - b. Item 5629 Multi-plane Hanging 1" Drop Hook Kit
 - c. Item 5630 Multi-plane Hanging 2" Drop Hook Kit
 - d. Item 5631 Multi-plane Hanging 3" Drop Hook Kit
 - e.
- C. Seismic Accessories Required

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations. (Exception: HumiGuard Max Ceilings)

3.2 PREPARATION

- A. Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors whose installation is specified in other sections.
 - 1. Furnish concrete inserts and similar devices to other trades for installation well in advance of time needed for coordination of other work.

3.3 INSTALLATION

- A. Install SoundScapes Shapes per Armstrong World Industries installation instructions.
- B. For areas having seismic requirements, consult with the Authority Having Jurisdiction or Building Code to determine the local requirements and following the manufacturers seismic guidelines found in the manufacturers Installation instructions.
- C. Install suspension system per ASTM C636 unless otherwise noted in the manufactures Installation Instructions.

3.4 ADJUSTING AND CLEANING

- A. Replace damaged and broken shapes.
- B. Clean exposed surfaces of shapes and suspension members comply with manufacturer's instructions for cleaning and touch up of minor finish damage.
- C. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

SECTION 09 51 00 - ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 WORK INCLUDED

- A. Provide and install all lay-in acoustical ceiling panels and suspended grid system in accordance with the drawings and as specified herein.
- B. Provide and install light fixture protection at all rated ceilings.
- C. Provide and install hold-down clips where required for rated system.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Steel joists (spacing)
- B. Mechanical (air devices)
- C. Electrical (lighting fixtures)

1.4 DRAWING REFERENCES

A. See drawings, finish schedule and Section 2.2 for ceiling types and ratings.

1.5 SUBMITTALS

- A. Submit manufacturer's product data describing all materials, finishes, ratings and installation requirements.
- B. Submit physical samples for each type of acoustical file proposed.
- C. Submit physical samples for each type of grid proposed.
- D. Submit tile manufacturer's certification for whether hold-down clips are required for the selected tile(s) and rated system(s).
- E. Reference Section 01 33 00 SUBMITTALS for additional submittal requirements.

1.6 WARRANTY

- A. Provide written warranty against defects in materials and workmanship for the work under this section for a period of one year after the date of Substantial Completion of the project.
- B. Warranted defects shall include but not necessarily be limited to rusting or deflection of grid, deterioration or deflection of acoustical tiles.
- 1.7 QUALITY ASSURANCE
 - A. Suspended acoustical ceiling contractor shall have a minimum of 3 years experience in the installation of specified systems for projects of similar size and scope of this project.
 - B. Installation of acoustical tile and panels shall not begin until residual moisture from plaster, drywall, concrete or terrazzo work is dissipated. Before installation, the building shall be enclosed and permanent heating and cooling equipment in operation.

1.8 DELIVERY AND STORAGE OF MATERIALS

- A. Do not deliver materials to jobsite until spaces are ready for ceiling installation.
- B. All materials shall be delivered in manufacturer's original packaging and stored in an enclosed shelter providing protection from damage and exposure to the elements.
- C. Damaged, rusted or deteriorated materials shall be removed from the premises.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. TYPICAL CEILING PANELS:1. Armstrong World Industries, Inc.
- B. SPECIALTY CEILING PANELS1. Armstrong World Industries, Inc.
- C. GRID SYSTEMS: 1. Armstrong World Industries, Inc.

2.2 MATERIALS:

- A. TYPICAL CEILING PANELS:
 - 1. 24" x 24" x 5/8" white "CALLA PrivAssure", square-edged as manufactured by Armstrong or equivalent (color, pattern, texture) by specified manufacturer. Non-rated system.
 - 2. 24" x 24" x 5/8" white "Fine Fissured" Angled Tegular as manufactured by Armstrong or equivalent (color, pattern, texture) by specified manufacturer. <u>Fire-rated system.</u>
- B. SUSPENSION SYSTEM:

- 1. Components shall be formed from commercial quality cold-rolled steel, electro-galvanized, 2'x2'module.
- 2. The suspension system shall support the ceiling assembly with a maximum deflection of 1/360 of the span per A.S.T.M. C-635-69.
- 3. Main tee with double web design 1-1/2" high and rectangular bulb; 15/16" exposed flange with rolled cap; cross tee holes at 6" o.c.
- 4. Four foot cross tee 1-1/2" high with double web design. Rectangular bulb joining main runners at 2' on center.
- 5. Two foot cross tees perpendicular to 4' cross tees. Two foot cross tees minimum of 1-1/2" high, No. CMC 222-41 or equivalent by specified manufactured.
- 6. Wall molding hemmed edge, electro-galvanized cold rolled steel with equal leg width, finish to match grid.
- 7. Finish: Typical finish, factory white painted steel. At high humidity areas including kitchens, dressing rooms, toilet rooms provide factory white painted aluminum cap.
- 8. Rating: Provide U.L. listed grid for scheduled system rating.

PART 3 – EXECUTION

3.1 COORDINATION

A. Verify that above ceiling work, including fire dampers, ductwork, piping, wiring and insulation is complete and approved prior to beginning ceiling work.

3.2 INSTALLATION

- A. Ceiling systems shall be suspended from structural members by 12 gauge annealed wire; spacing as recommended by manufacturer. Provide additional support for light fixtures and grilles at each corner. Provide secondary support framing ("Unistrut") where spacing of structural members exceeds suspension system manufacturer's recommendations.
- B. Acoustical lay-in panels shall be installed in strict accordance with the manufacturer's instructions. Tile shall be installed with fissures or pattern all in same direction.
- C. Provide additional hangers at ceiling suspended items including projection screens, speakers, exit lights, air supply and return grilles.
- D. Space main runner hangers a maximum of 6 inches from wall. Do not support systems from wall.
- E. Adjust hangers to ensure level ceiling in plane.

3.3 RATED CEILINGS

- A. Provide specified ceilings in fire rated assembly. Protect light fixture protection in accordance with approved U.L. Design to meet required assembly rating. Provide additional hangers to meet the requirements of the particular U.L. rating.
- B. Ceiling system manufacturers not listed in the required U.L. design number (reference drawings) shall be responsible for determining whether their rated system is acceptable to the particular local code authority.
- C. For ceiling tiles weighing 1 lb. per square foot or more, verify no requirement for hold-down clips at rated systems.

3.4 CLEANING AND REPLACEMENT

- A. At completion, replace file unit and grid systems that are damaged. Clean or replace tile and grid systems that cannot be cleaned.
- B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Furnish quantity not less than 5 percent for each color, pattern, and type of ceiling tile installed.

SECTION 09 65 13 - RESILIENT WALL BASE AND ACCESSORIES

PART 1 – GENERAL

1.0 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.1 SUMMARY

- A. Section Includes:
 - 1. Resilient base.
 - 2. Resilient molding accessories.
- B. Related Sections:
 - 1. Section 09 65 19 Resilient Floor Tile.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of product indicated.
- C. Product Schedule: For resilient products.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

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 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.5 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 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.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 – PRODUCTS

2.1 RESILIENT BASE

- A. Resilient Base:
 - 1. Manufacturers: Subject to compliance with requirements, [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. Armstrong World Industries, Inc.
 - b. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
 - c. Johnsonite.
 - d. Roppe Corporation, USA.
- B. Resilient Base Standard: ASTM F 1861.
 - 1. Material Requirement: Type TS (rubber, vulcanized thermoset).
 - 2. Manufacturing Method: Group I (solid, homogeneous).
 - 3. Style: Cove (base with toe).
- C. Minimum Thickness: 0.125 inch (3.2 mm)
- D. Height: 4 inches (102 mm).
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Preformed.
- G. Inside Corners: Preformed.
- H. Finish: Matte.
- I. Colors and Patterns: As selected by Architect from full range of industry colors.

2.2 RESILIENT MOLDING ACCESSORY

- A. Resilient Molding Accessory:
 - 1. Manufacturers: Subject to compliance with requirements, [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. Johnsonite.
 - b. Roppe Corporation, USA.
 - c. Burke Mercer Flooring Products
- B. Description: Provide as required for complete installation
 - 1. Carpet edge for glue-down applications,
 - 2. Nosing for carpet
 - 3. Nosing for resilient floor covering
 - 4. Reducer strip for resilient floor covering
 - 5. Joiner for tile and carpet
 - 6. Transition strips.
- C. Material: Rubber.
- D. Profile and Dimensions: Manufactures standard profile and dimensions.
- E. Colors and Patterns: As selected by Architect from manufacturer's full range.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and

substrate conditions indicated.

- 1. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.

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 products.
- 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. Do not install resilient products until they are same temperature as the space where they are to be installed.
 - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- D. Sweep and 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.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of carpet and resilient floor covering that would otherwise be exposed.

3.5 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. Sweep and vacuum surfaces thoroughly.
 - 3. 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.
- D. Cover resilient products until Substantial Completion.

SECTION 09 91 00 – PAINTING AND FINISHING

PART 1 - GENERAL

1.1 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.2 WORK INCLUDED

- A. Provide all labor, materials, and equipment required for all painting, staining and finishing as indicated in the drawings, the approved submittals, and as specified herein. Painted or stained systems include but are not necessarily limited to the items listed below:
- B. EXTERIOR SYSTEMS:
 - 1. All visible wood unless noted otherwise.
 - 2. All ferrous metal. All galvanized metal unless noted otherwise. Touch-up on welds or damaged finishes.
 - 3. Exposed conduit, piping, etc., except for roof mounted piping not visible.
 - 4. Exposed roof mounted equipment visible from ground level or from upper floors of the building.
 - 5. All exposed concrete masonry units.
 - 6. All items normally painted in accordance with good construction practice.

C. INTERIOR SYSTEMS:

- 1. All visible wood or behind cabinet doors unless noted otherwise.
- 2. All ferrous metal. All galvanized metal unless noted otherwise. Touch-up on welds or damaged finishes. Structural steel, steel joists and deck exposed to view except in mechanical rooms.
- 3. Exposed conduit, piping, outlet boxes, raceways, and panel boxes except galvanized or aluminum piping located in mechanical or electrical rooms.
- 4. All exposed concrete masonry units, gypsum board and plaster unless otherwise noted.
- 5. All factory-primed hardware. Back-priming of all wood trim, millwork or finished carpentry prior to installation.
- 6. All hollow metal doors and frames.
- 7. All items normally painted in accordance with good construction practice.
- 8. All unfinished louvers and grilles.

1.3 WORK TYPICALLY EXCLUDED

- A. Shop applied primer on structural steel and miscellaneous metals items.
- B. Aluminum frames, doors, and windows.
- C. Plastic clad casework, millwork, and wall panels.
- D. Factory finished equipment unless noted otherwise (provide job touch-up).
- 1.4 DRAWING REFERENCE: Reference any paint or finish notes in the drawings for any pre-selected colors or other requirements.

1.5 SUBMITTALS

- A. Submit manufacturer's product data describing each proposed type of paint, sealer, stain, or coating and it's recommended use. Include viscosity and percent solids information. Where not the specified base manufacturer, list the specified brand name and type and the proposed substitute. The Architect shall be the sole judge as to equivalency of systems.
- B. Reference Section 01 33 00 SUBMITTALS for additional submittal requirements.

1.6 WARRANTY

- A. Provide written warranty against defects in materials and workmanship for the work under this section for a period of two years after the date of Substantial Completion of the project.
- B. Warranted defects shall include but not necessarily be limited to peeling, crazing, cracking, blistering, mildewing, chalking or dusting, pin holes, color fade or loss of hardness or sheen.

1.7 QUALITY ASSURANCE

- A. Painting contractor shall have a minimum of 5 years experience in the application of the specified systems for projects of similar size and scope as this project.
- B. If requested by the Architect, provide system manufacturer's certification of the proposed painting contractor as approved for application of the product.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Do not deliver painting materials to the jobsite until spaces and surfaces are ready for painting.
- B. Deliver materials in manufacturer's original containers, unopened except for shop mixing of colors. Containers shall bear manufacturer's readable labels indicating brand and type of paint. Any additional containers with labels indicating products not approved shall be removed form the jobsite. Any applied material not previously approved by the Architect is subject to removal and reapplication with the appropriate approved product.
- C. Store materials in environmentally controlled area. Interior products shall be acclimated to a temperature range of 50-80 degrees F. at least 24 hours prior to application.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. TYPICAL PAINTS: Systems are based on the first listed manufacturer. Only equivalent systems provided by specified manufacturers in accordance with attached Product Comparison sheet and as approved by the Architect are approved for use.
 - 1. Sherwin Williams, Inc.
 - 2. Pittsburgh Paints
 - 3. Pratt & Lambert
 - 4. Benjamin Moore Co.
- B. SPECIALTY PAINTS:
 - 1. Epoxies: Sherwin Williams, PPG, Pratt & Lambert.
- C. SUBSTITUTIONS: In accordance with Section 01 25 00 Substitution Procedures.

2.2 INTERIOR SYSTEMS

- A. SYSTEM TYPES FOR NEW WALLS (Unless indicated otherwise on Finish Schedule or drawings):
 - 1. Drywall in toilet rooms, storage rooms, and mechanical/electrical/toilet rooms/ classrooms: Semi Gloss Enamel at walls and ceilings.
 - 2. Drywall soffits: Eggshell Enamel.
 - 3. Typical masonry (CMU): Gloss Enamel.
 - 4. Masonry (CMU) in toilet rooms: **Gloss Epoxy.**
 - 5. Steel railings: Gloss Aliphatic Urethane.
- B. SYSTEM DESCRIPTIONS (Reference item 3.3 for modifications and preparation required for these systems when applied to existing walls already painted):
 - 1. <u>Primer on gypsum board:</u> SW PrepRite High Build Primer B28W601 one coat over light to medium texture (submit texture sample for approval)
 - 2. <u>Eggshell Enamel on Drywall:</u> SW Pro Mar 400 Latex Eg-Shel B20W4400 one coat over specified primer.
 - 3. <u>Semi-Gloss Enamel on Drywall:</u> SW Pro Mar 400 Latex Semi Gloss B31W4400 one coat over specified primer.
 - 4. <u>Epoxy Paint on Drywall:</u> One coat SW PrepRite 200 Latex Primer B28W200 over specified primer.
 - 5. <u>Gloss Enamel on Drywall:</u> Two coats SW Water Based Catalyzed Epoxy B70 Series gloss acrylic over specified primer.
 - 6. <u>Semi-Gloss Enamel on shop-primed metals</u>: SW Water Based Industrial Enamel B53-300 acrylic gloss Enamel two coats.
 - 7. <u>Natural Finish on Wood</u>: SW Sherwood BAC Wiping Stain (one coat) + SW Wood Classics Sanding Sealer B26V3 (one coat) + SW Wood Classics Satin Varnish A66.
 - 8. <u>Clear Finish on Wood</u>: SW Wood Classics Polyurethane Varnish A67 (two coats). Sand lightly between all coats.
 - 9. <u>Block Filler</u>: SW Prep Rite Block Filler B25W25 (for areas not subject to moisture); SW Heavy Duty Block Filler (for areas subject to moisture). Provide 2 coats as specified under "Execution".
 - 10. <u>Gloss Enamel on CMU or concrete</u>: Two coats block filler plus two coats SW Water based Industrial Enamel gloss acrylic latex over specified primer.

- 11. <u>Semi-Gloss Enamel on CMU or concrete</u>: Two coats block filler plus two coats SW Water Based Industrial Enamel semi-gloss acrylic latex over specified primer.
- 12. <u>Semi-Gloss Epoxy Paint on concrete</u>: One coat SW Water Based Epoxy semi-gloss over cured concrete plus finish coat of SW Water Based Epoxy semi-gloss. Minimum paint thickness 3.0 dry mils.
- 13. <u>Gloss Epoxy Paint on CMU</u>: Two coats block filler (unless surface-bonded) plus finish coat of gloss. Minimum paint thickness 3.0 dry mils.
- 14. <u>Gloss Epoxy Paint on concrete</u>: One coat SW Water Based Epoxy gloss over cured concrete plus finish coat of SW Water Based Epoxy gloss. Minimum paint thickness 3.0 dry mils.
- 15. <u>Semi-Gloss Enamel on utility piping and galvanized metals</u>: SW Pro-Cryl Universal Metal Primer – one coat + SW DTM Acrylic Semi Gloss – two coats.
- 16. <u>Semi-Gloss Epoxy Paint on CMU</u>: Two coats block filler plus finish coat of SW Water Based Epoxy semi-gloss. Minimum paint thickness 3.0 dry mils.
- 17. <u>Gloss Aliphatic Urethane Enamel on primed steel railings:</u> Over epoxy shop primer apply two coats SW Hydrogloss Single Component Water Based Urethane B65-181 Urethane Gloss Enamel using airless spray equipment.
- 18. <u>Dry Fall Acrylic</u> (exposed deck, structure and rigging): One coat SW Super Save Lite Acrylic Dry Fall Eggshell Primer & Finish. Black color. Overspray dries to non-adhering dust in a ten foot fall.

2.3 EXTERIOR SYSTEMS

A. SYSTEM TYPES:

- 1. Exterior Metals: Gloss Enamel.
- 2. Field welds: Zinc-Rich Coating.

B. SYSTEM DESCRIPTION:

- 1. <u>Gloss Enamel on Galvanized Metals:</u> SW Pro-Cryl Universal Metal Primer B66W310 (one coat) + SW Sher-Cryl HPA B66-300 enamel – two coats.
- 2. <u>Block Filler on CMU:</u> SW Heavy Duty Block Filler B24W46, one coat.
- 3. <u>Gloss Enamel on Shop-Primed Metals:</u> SW Sher-Cryl HPA B66-300 gloss enamel-two coats.
- 4. <u>Gloss Enamel on Aluminum:</u> SW Pro-Cryl Universal Metal Primer B66W310 (one coat) + SW Sher-Cryl HPA B66-300 gloss enamel two coats.
- 5. <u>Field Welds:</u> "ZRC" cold-applied galvanizing.

PART 3 - EXECUTION

3.1 PREPARATION

- A. METALS: Remove grease, oil, and dirt. Touch-up any damaged primer with like material. Remove any welding tags and grind smooth before painting. Fill any open galvanizing ports.
- B. PLASTER, CMU, CONCRETE: Remove dusting and mortar residue. Remove any efflorescence and seal. Ensure that plaster, concrete and mortar joints are dry and fully cured.

3.2 APPLICATION

A. GENERAL: All paint and finishes be brushed or sprayed in even, uniform coats without runs or sags. Allow each coat to dry completely before applying succeeding coats. All surfaces shall be dry and no painting shall be done in damp conditions or when the ambient temperature is below 50 degrees F.

- B. WOOD DOORS: Factory sealed tops, bottoms, and edges of plastic laminate surfaced doors left undisturbed require no additional finishing. Reseal any job cuts. Paint metal glazing stops.
- C. MECHANICAL/ELECTRICAL EQUIPMENT: Painting contractor shall examine the mechanical and electrical drawings to determine quantities and locations of exposed piping, louvers not shown in Architectural drawings, electrical and telephone panels in finished areas, exposed electrical conduit in finished areas.
- D. BLOCK FILLER AT CMU: Apply **first coat** of filler to ensure penetration into voids and work into block texture with bristle brush. Follow with a **minimum of one additional coat**. Provide uniform finish with no pinholes.
- E. DRYWALL: Paint finish, sheen and texture shall be uniform and match the samples submitted to and approved by the Architect.

3.3 PREPARATION OF EXISTING PAINTED SURFACES

- A. Maintenance painting will frequently not permit or require complete removal of all old coatings prior to repainting. However, all surface contamination such as oil, grease, loose paint, mill scale dirt, foreign matter, rust, mold, mildew, mortar, efflorescence, and sealers must be removed to assure sound bonding to the tightly adhering old paint. Glossy surfaces of old paint films must be clean and dull before repainting. Thoroughly washing with an abrasive cleanser will clean and dull in one operation, or, wash thoroughly and dull by sanding. Spot prime any bare areas with an appropriate primer.
- B. Recognize that any surface preparation short of total removal of the old coating may compromise the service length of the system. Check for compatibility by applying a test patch of the recommended coating system, covering at least 2 to 3 square feet. Allow to dry one week before testing adhesion per ASTM D3359. If the coating system is incompatible, complete removal is required.

PART 4 – SCHEDULES

4.1 COLOR SELECTIONS

- A. SCHEDULE: Unless colors are pre-selected in the Bidding Documents, the Architect shall prepare color schedule for the project using colors selected from the approved paint manufacturer(s). Where colors are pre-selected, the painting contractor shall use the colors selected or submit a schedule of proposed exact color matches by one of the specified paint manufacturers. **Provide 12" x 12" samples of actual paint** for each color whether pre-selected color or proposed color match.
- B. DOCUMENTATION: Upon completion of the Project, painting contractor shall furnish to the Architect a complete schedule of paint brands, types, and colors actually used for each room and area.

4.2 EXTRA MATERIALS

C. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Furnish quantity not less than 5 percent for each color (field and accent) of paint used.

SECTION 10 11 23 – GLASS MARKER BOARDS

PART 1 – GENERAL

1.00 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.01 SUMMARY

- A. Perform all work required to complete the bulletin boards, and marker boards indicated by the Contract Documents and furnish all supplementary items necessary for its proper installation.
- B. The requirements of Division 0 "Bidding and Contract Requirements" and Division 1 "General Requirements" of this Project Manual shall apply to all Work required for this Section.

1.02 SUBMITTALS

A. SAMPLES:1. Submit for approval samples of typical accessories showing construction and finish specified.

- B. SHOP DRAWINGS:
 - 1. Submit manufacturer's literature and mark sufficiently to indicate compliance with these specifications. Show locations, methods of supporting, methods of anchoring and finishes of each accessory.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Material manufacturer by any of the following manufacturers is acceptable, provided it complies with the Contract Documents.
 - 1. Claridge Products and Equipment, Inc.
 - 2. Newline

2.02 MATERIALS

A. GLASS MARKERBOARD W/ INVISI-MOUNT: ¹/₄" low iron ultra clear magnetic glass; overall ¹/₄" thick; wt. 2 1/2" lbs./sq. ft.; colors to be selected from manufacturer's standard colors. <u>Size: 4'</u> <u>x 10'.</u>

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved shop drawings. Install accessories plumb, square, level and true with wall or surfaces.
- B. Frames of recessed accessories shall neatly trim the opening. Gaps and voids between frames and finished walls will not be allowed. Exposed and concealed fasting shall match finish or fixtures and shall be stainless steel, theft proof type.
- C. Install concealed anchor plates to wall construction for mounting. Provide grounds or rough bucks, where required, to rigidly secure accessories.

3.02 CLEANING

A. Remove all manufacturer's temporary labels or marks of identification. Clean and polish to remove all oil, grease, and foreign material. Leave in a neat, orderly and clean condition acceptable to the Architect.

SECTION 10 14 00 — GRAPHICS AND SIGNAGE

PART 1 - GENERAL

1.1 COORDINATION:

- A. The General Conditions of the Contractor for Construction and the Supplementary Conditions to the General Conditions of the Contract for the Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addendum issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the stringent requirements and the greater quantity shall apply.

1.2 WORK INCLUDED

- A. Material and installation for the Plastic Room Identification Plaques.
- B. Material and Installation for Exterior/Interior Building Identification Letters.
- C. Material and Installation For Building Dedication Plaque with logos (including but not limited to conversion of architectural drawings into useable vector line art format).

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Interior wall materials and finishes.
- B. Exterior wall materials and finishes.
- C. Typical handicapped site signage.

1.4 SUBMITTALS

- A. Submit manufacturer's product data describing materials, and mounting methods for Room Identification Plaques, Exterior/Interior Building Identification Letters, and Building Dedication Plaque.
- B. Submit color samples of actual material for color and finish selection by Architect.
- C. Submit finished sample of room identification plaque(s) with any required symbols other than text.
- D. Submit paper "rubbing" of final layout of Building Dedication Plaque for Architect's approval.
- E. Submit full size paper layout of Exterior Building Identification Letters for each line of text.
- F. Reference Section 01 33 00 SUBMITTALS for additional submittal requirements.

1.5 WARRANTY

- A. Provide written warranty against defects in materials and workmanship for the work under this section for a period of one year after the date of Substantial Completion of the project.
- B. Warranted defects shall include but not necessarily be limited to color fading, delamination, failure of anchoring or fastening, cracking, breaking or tarnishing.
- C. Exterior signage or building letters contributing to streaking or staining of building shall be a defect to be corrected by the Contractor, with building materials cleaned or replaced as required.

1.6 QUALITY ASSURANCE

A. Fabrication and installation company shall have a minimum of 3 years experience in the installation of similar systems for projects of similar size and scope.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Do not deliver materials to the jobsite until surfaces are ready for installation of graphics.
- B. Store materials in covered, dry, temperature and humidity controlled space.

2 PART TWO – PRODUCTS

2.1 MANUFACTURERS

- A. ROOM IDENTIFICATION PLAQUES:
 - 1. Corpus Christi Stamp Works
 - 2. Sign International
 - 3. Multi-Graphics Incorporated
- B. LOBBY LOGO SIGNAGE LETTERS:
 - 1. A.R.K. Ramos
 - 2. Gemini Inc.
 - 3. Matthews Architectural Products
 - 4. CNDSIGNS

C. BUILDING DEDICATION PLAQUE:

- 1. A.R.K. Ramos
- 2. Matthews Architectural Products
- 3. The Southwell Co.
- 4. Sign International

2.2 MATERIALS

- A. ROOM IDENTIFICATION PLAQUES:
 - 1. 6" X 9" X $\frac{1}{4}$ " thick two tone series:
 - 2. Fabrication: Constructed of Wilson Art face laminate (as selected by the Architect from manufacturer's standard selections) laminated to a solid acrylic core. The raised 1/32" acrylic copy

shall be cut through the laminate face color and chemically welded to the acrylic core to assure permanent attachment, including the symbols. Any lower and secondary copy shall be 5/8" high Helvetica Medium (all caps) incised copy paint filled. Colors as selected by the Architect. Any secondary copy shall be 8-stroke computer engraved. Rounded corner letters will not be acceptable. The edge of the signs shall be finished to match the face laminate color-to-color as selected by the Architect.

- 3. At toilet rooms also provide with 2" high raised gender and wheelchair symbols when handicapped equipped noted on schedule. Symbols shall be chemically welded through the face laminate to the acrylic core. Edges painted a color as selected.
- 4. The raised copy shall be accompanied with grade 2 Braille by means of Visi Touch DuraDot Braille manufacturing system. The clear Glass DuraDot shall have a 0.059 surface diameter and raised 1/32" above the face laminate and shall be unitized to the acrylic core through the face laminate. The edges of the sign shall be finished to match the face laminate color-to color as selected by the Architect. Any secondary copy shall be 8-stroke computer engraved. Rounded corner letters will not be acceptable.
- 5. Installed plaques shall comply with all state, local, and federal requirements for compliance.

B. LOBBY SIGNAGE LETTERS/ LOGO

- 1. <u>Scope:</u> The project shall include a cast letters as described below, to be provided and installed by contractor. Letterstyle, finish and mounting to be selected by Architect.
- 2. <u>Fabrication of Letters</u>: Fabricate letters to comply with requirements indicated below and as indicated on drawings.
 - A. Cut letters : Form letters by cutting from solid sheet material of thickness specified. Produce characters with smooth flat faces, sharp corners, precisely formed lines and profiles, free from pits, scale, sand holes and other defects. Supply anchoring devices on reverse side of individual letters as required.
- 3. Characteristics:
 - A. Metal: Aluminum
 - B. Size: as noted on drawings.
 - C. Thickness: 3/8 inch
 - D. Letterstyle: Sans Serif (match logo)
 - E. Finish: As selected by Architect from manufacturer's finish options (submit samples).
 - F. Mounting: Concealed (refer to drawings for wall type), 2" from wall
 - G. Text: "EDINBURG" & LOGO
- 4. <u>Template:</u> Provide full size paper mounting template showing hole placement and location of mounting holes.
- 5. <u>Finishes:</u> Colors and surface textures for exposed letters as selected by the architect from the manufacturer's standard and *premium* selections.

C. BUILDING IDENTIFICATION PLAQUE:

- 1. 18" wide X 24" high cast bronze alloy plaque. Borders and raised text shall have satin finish. Background shall receive a dark oxidized leatherette finish. Faces and edges to be chemically cleaned and sprayed with two coats of clear acrylic lacquer.
- 2. Provide threaded stainless steel or brass studs on back for concealed mounting with epoxy. Letter style "Helvetica Medium" per A.R. Ramos or equivalent by specified manufacturer.

3. Layout, logos and letter sizes to be provided by the Architect. General contractor shall perform all conversions of architectural drawings & logos into useable vector line art format or any other type of format as required in order to produce the building plaque layout as provided by the Architect.

3 PART THREE- EXECUTION

3.1 INSPECTION AND PREPARATION

- A. Ensure that wall surfaces are completed and accepted by the Architect prior to installing wall-mounted items or painted wall graphics.
- B. Obtain approved location schedule for Room Identification Plaques prior to delivery of plaques to the jobsite.

3.2 INSTALLATION

- A. ROOM IDENTIFICATION PLAQUES:
 - 1. Apply top and bottom strips of 1/8" thick double stick vinyl foam tape and backs of each plaque. Apply liberal amount of clear silicone rubber adhesive to a minimum of 50% coverage of back of plaque.
 - 2. Plaques shall be mounted to the strike side of the door on the wall within 5' of the floor and 6" max. from the jamb; when location is on a glass side light or window, mount with a solid color back-up plate to cover reverse side of the glass. Attachment shall be with foam tape and silicone.
- B. BUILDING DIRECTIONALS SIGNS:
 - 1. Apply top and bottom strips 1/8" thick double stick vinyl foam tape on backs of each sign. Apply liberal amount of clear silicone rubber adhesive to a minimum of 50% coverage of back of sign.
 - 2. Signs shall be mounted to the strike side of the door on the wall within 5' of the floor and 6" max. from the jamb; when location is a glass sidelight or window, mount with a solid color back-up plate to cover reverse side of the glass. Attachment shall be with foam tape and silicone.

C. EXTERIOR/INTERIOR BUILDING IDENTIFICATION LETTERS.

1. Pre-drill holes into masonry and insert threaded stud on back of letters into epoxy adhesive filled holes. Provide stainless steel spaces to set letters off wall ¹/₂" minimum 2 studs per letter. Refer to drawings for wall finish type.

D. BUILDING IDENTIFICATION PLAQUE:

- 1. <u>Masonry Wall:</u> Pre-drill holes into masonry walls and insert threaded studs on back of letters into epoxy adhesive filled holes. Mount plaque tight against wall.
- 2. <u>Drywall:</u> Mount plaque using a minimum of 4 moly type expansion screws and silicone adhesive. Mount plaque tight against wall.

SECTION 10 44 00 - FIRE EXTINGUISHERS AND CABINETS

PART 1 GENERAL

1.0 COORDINATION

- A. The General Conditions of the Contract for Construction and the Supplementary Conditions to the General Conditions of the Contract for Construction shall be considered as part of this section of the specifications.
- B. Each Bidder shall be responsible for determining during the bidding period the extent that any addenda issued during the bidding period may affect this section of the specifications.
- C. Reference Instructions to Bidders for requirements regarding substitutions of materials and products.
- D. Where conflicts occur between the drawings and specifications, between different drawings, between different portions of this section of the specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.

1.01 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Accessories.

1.02 RELATED SECTIONS

- A. Section 04 22 00 Concrete Masonry Units; CMU walls to receive bracket mounted fire extinguisher.
- B. Section 06 10 00 Rough Carpentry: Wood blocking and framing to receive semi-recessed fire extinguisher cabinets.
- C. Section 09 21 16 Gypsum Drywall Assemblies: Finished openings in walls for semi-recessed fire extinguisher cabinets.

1.03 REFERENCES

- A. NFPA 10 Standard for Portable Fire Extinguishers; National Fire Protection Association; 2002.
- B. UL (FPED) Fire Protection Equipment Directory; Underwriters Laboratories Inc.; current edition.

1.04 PERFORMANCE REQUIREMENTS

- A. Conform to NFPA 10.
- B. Provide extinguishers classified and labeled by Underwriters Laboratories Inc. for the purpose specified and indicated.

1.05 SUBMITTALS

- A. See Section 01 33 00 Submittals, procedures and requirements for shop drawings, product data and submittal requirements.
- B. Shop Drawings: Indicate cabinet physical dimensions.
- C. Product Data: Provide extinguisher operational features.
- D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fire Extinguishers, Cabinets and Accessories:
 - 1. JL Industries, Inc; Product 1037B20 with Extinguisher: <u>www.jlindustires.com</u>.
 - 2. Larsen's Manufacturing Co: <u>www.larsensmfg.com</u>.
 - 3. Potter-Roemer: <u>www.potterroemer.com</u>.
 - 4. Substitutions: See Section 01 25 00 Product Requirements.

2.02 FIRE EXTINGUISHERS

- A. Basis of Design: JL Industries, "Cosmic 10E".
- B. Type: Multipurpose dry chemical.
- C. Rating: Sized for project requirements.
- D. Mounting: Refer to floor plans for locations, annotated FEC for cabinets and FE extinguishers alone.
- E. Dry Chemical Type: Stainless steel tank, with pressure gage.
 - 1. Class A:B:C.
 - 2. Size 10.
 - 3. Finish: Baked enamel, Red color.
- G. ALL fire extinguishers shall be inspected and certified by the local authority having jurisdiction that they are charged and ready for use and shall be "tagged" identifying such.

2.03 FIRE EXTINGUISHER CABINETS

- A. Basis of Design:
 - 1. JL Industries, "Cosmopolitan 1035B20 ADAC with Saf-T-Loc, TAS compliant.
 - 2. Designations: Refer to the floor plans, FEC for Extinguishers in cabinets and FE for surface mounted extinguishers secured to walls.

- B. Surface Mounted (Non-Cabinet, FE Type) Bracket and Extinguisher (non-cabinet): Manufacturer's standard stainless steel strap with enamel finished bracket with locking band retainer.
 - 1. Bracket shall match the extinguisher type.
- C. Metal for Cabinets: Formed stainless steel sheet; 0.036 inch thick base metal; #4 finish stainless steel.
- D. Cabinet Configuration: Recessed type.
 - 1. Sized to accommodate accessories.
 - 2. Exterior nominal dimensions of 13 7/8 inch wide x 27 3/8 inch high x 6 inch deep.
 - 3. Trim: Returned to wall surface, with 3 inch projection, 1 1/2 inch wide face.
 - 4. Form cabinet enclosure with right angle inside corners and seams. Form perimeters trim and door stiles.
- E. Door: 0.036 inch thick, reinforced for flatness and rigidity; lock with full glass access. Hinge doors for 180 degree opening with two butt hinge. Provide nylon catch.
- F. Door Glazing: Glass, clear, 1/8 inch thick float. Set in resilient channel gasket glazing.
- G. Cabinet Mounting Hardware: Appropriate to cabinet. Pre-drill for anchors.
- H. Weld, fill, and grind components smooth.
- I. Finish of Cabinet Interior: Enamel, color to select from manufacturer's full color line.

2.04 ACCESSORIES

- A. Extinguisher Brackets: Formed steel, chrome-plated.
- B. Cabinet Signage: FIRE EXTINGUISHER, vertical up face of cabinet to one side.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install cabinets plumb and level in wall openings, 30 inches from finished floor to inside bottom of cabinet.
- C. Secure rigidly in place.
- D. Place extinguishers in cabinets.

SECTION 21 13 13

WET-PIPE SPRINKLER SYSTEMS

1.1 GENERAL

1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Furnish and install complete wet-pipe fire sprinkler system as specified in Contract Documents.
 - 2. Furnish and install **Firestop Penetration Systems** for fire sprinkler system penetrations as described in Contract Documents.

2 REFERENCES

- **A.** Association Publications:
 - 1. Underwriters Laboratories, Inc.:
 - I. UL Directory B, 'Fire Protection Equipment Directory' (2011).
- **B.** Reference Standards:
 - 1. American National Standards Institute / American Society of Mechanical Engineers:
 - I. ANSI/ASME B1.20.1-1983(R2006), 'Pipe Threads, General Purpose (Inch)'.
 - II. ANSI/ASME B16.1-2010, 'Cast Iron Pipe Flanges and Flanged Fittings'.
 - III. ANSI/ASME B16.3-2011, 'Malleable Iron Threaded Fittings: Classes 150 and 300'.
 - IV. ANSI/ASME B16.4-2011, 'Gray Iron Threaded Fittings, Classes 125 and 250'.
 - V. ANSI/ASME B16.5-2009, 'Pipe Flanges and Flanged Fittings'.
 - 2. American National Standards Institute / American Water Works Association:
 - I. ANSI/AWWA C606-11, 'Grooved and Shouldered Joints'.
 - 3. American National Standards Institute / American Welding Society:
 - I. ANSI/AWA B2.1/B2.1M-2009, 'Specification for Welding Procedure and Performance Qualification'.
 - 4. ASTM International:
 - I. ASTM A53/A53M-12, 'Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless'.
 - II. ASTM A135/A135M-09, 'Standard Specification for Electric-Resistance-Welded Steel Pipe'.
 - III. ASTM A234/A234M-11a, 'Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service'.
 - IV. ASTM A395/A395M-99(2009), 'Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures'.
 - V. ASTM A536-84(2009), 'Standard Specification for Ductile Iron Castings'.
 - VI. ASTM A795/A795M-08, 'Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use'.
 - 5. National Fire Protection Association / American National Standards Institute:
 - I. NFPA 13: 'Standard for the Installation of Sprinkler Systems', (2010 Edition).
 - II. NFPA 24: 'Installation of Private Fire Service Mains and their Appurtenances', (2010 Edition).
 - III. NFPA 25: 'Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems', (2011 Edition).
 - IV. NFPA 101: 'Life Safety Code', (2012 Edition).

3 SUBMITTALS

A. Action Submittals:

- 1. Shop Drawings:
 - I. Size sprinkler system piping and sprinklers by one of following methods: a Hydraulic calculation design method based on water supply availability.
 - II. On submittals, refer to sprinkler heads by sprinkler identification or model number published in appropriate agency listing or approval. Trade names and other abbreviated designations are not acceptable.
 - III. Submittal Procedure:
 - a After award of Contract and before purchase of equipment, submit seven sets of shop drawings with specifications and hydraulic calculations to Architect and two sets to local jurisdiction having authority for fire prevention for review.
 - b After integrating Architect's and AHJ's comments into drawings, licensed certified fire protection engineer of record who designed fire protection system shall stamp, sign, and date each sheet of shop drawings and first page of specifications and calculations.
 - c Submit stamped documents to Owner and to AHJ for fire prevention for final approval.
 - d After final approval, submit four copies of approved stamped documents to Architect.
 - e Failure of system to meet requirements of authority having jurisdiction and/or approved stamped construction documents shall be corrected at no additional cost to Owner.
- B. Informational Submittals:
 - 1. Qualification Statement:
 - I. Licensed fire protection engineers or fire protection system designer:
 - a Licensed for area of Project.
 - b Certified by NICET to level three minimum.
 - c Provide Qualification documentation if requested by Architect or Owner.
 - II. Installer:
 - a Provide Qualification documentation if requested by Architect or Owner.
- **C.** Closeout Submittals:

I.

- 1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
 - Operations and Maintenance Data:
 - a Maintenance and instructions.
 - List of system components used to indicate name and model of each item. Manufacturer's maintenance instructions for each component installed in Project.
 - Instructions shall include installation instructions, parts numbers and lists, operation instructions of equipment, and maintenance and lubrication instructions.
 - II. Warranty Documentation:
 - a Include copies of required warranties.
 - III. Record Documentation:
 - a Include copies of approved shop drawings.
 - b Provide master index showing items included.
 - c Provide name, address, and phone number of Architect, Architect's Fire Sprinkler Consultant, General Contractor, and Fire Protection subcontractor.
 - d Provide operating instructions to include:
 - General description of fire protection system.
 - Step by step procedure to follow for shutting down system or putting system into operation.

- e Provide copy of system's above ground and below ground hydrostatic tests. Provide separate copies for Architect and Owner.
- f Provide copy of 'Contractor's Material and Testing Certificate for Above Ground Piping' NFPA 13, Figure 24.1 (2010 edition).
- 2. Inspection:
 - I. Provide Owner with latest version of NFPA 25.
- **D.** Maintenance Material Submittals;
 - 1. Extra Stock Materials:
 - Spare sprinkler heads in the quantity recommended by NFPA 13 selected in representative proportion to quantity used in Project and in accordance with NFPA 13 (Six (6) spare sprinkler heads minimum).
 - II. Provide spare heads in cabinet with sprinkler head wrench for each type of head used. After approval of cabinet and contents, mount cabinet in convenient location in Riser Room.

4 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:
 - 1. Unless noted otherwise, system shall conform to:
 - I. NFPA 13, 'Light & Ordinary Hazard Occupancies'.
 - II. NFPA 24, 'Service Mains and Their Appurtenances, Private'.
 - III. NFPA 25, 'Inspection, Testing, and Maintenance.
 - IV. NFPA 101, 'Life Safety Code'.
 - V. Requirements of local water department and local authority having jurisdiction for fire protection.
 - VI. Underwriters Laboratories Publication, UL Directory B, 'Fire Protection Equipment Directory', current edition at time of Pre-Bid Meeting.
 - VII. Comply with backflow prevention requirements and, if required, include device in hydraulic calculations.
 - VIII. Applicable rules, regulations, laws, and ordinances.
- B. Qualifications:
 - 1. Licensed fire protection engineer or fire protection system designer certified by NICET to level three minimum and engaged in design of fire protection systems. Engineer / designer shall:
 - I. Licensed for area of Project.
 - II. Minimum five (5) years experience in fire protection system installations.
 - III. Minimum five (5) satisfactorily completed installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
 - IV. Be responsible for overseeing preparation of shop drawings, hydraulic calculations where applicable, and system installation.
 - V. Make complete inspection of installation.
 - VI. Provide corrected record drawings to Owner with letter of acceptance.
 - VII. Certify that installation is in accordance with Contract Documents.
 - VIII. Upon request, submit documentation.
 - 2. Installer:
 - I. Licensed for area of Project.
 - II. Minimum five (5) years experience in fire protection system installations.
 - III. Minimum five (5) satisfactorily completed installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
 - IV. Upon request, submit documentation.

1.2 PRODUCTS

1 SYSTEM

- A. Description:
 - 1. Automatic wet-pipe fire sprinkler system starting at flange in Fire Riser Room and extending throughout the building as shown on the fire sprinkler drawings.

B. Performance:

I.

- 1. Design Criteria:
 - Area of Application and Corresponding Design Density:
 - a Serving Area and Mechanical, Electrical, and Janitorial Areas:
 - Ordinary Hazard Group 1.
 - Design density = 0.15 gpm per sq ft over 1,500 sq ft (140 sq m).
 - b Storage Areas:
 - Ordinary Hazard Group 2.
 - Design density = 0.20 gpm per sq ft over 1,500 sq ft (140 sq m).
 - c All Other Areas:
 - Light Hazard.
 - Design density = 0.10 gpm per sq ft over 1,500 sq ft (140 sq m).
 - d Increase remote areas by 30 percent where ceiling / roof is sloped more than 2 inches (50 mm) per ft.
 - e Remote areas may be reduced within parameters indicated in NFPA 13 for use of quick response sprinklers throughout.
 - II. Maximum Coverage per Sprinkler Head:
 - a Ordinary Hazard Areas: 130 sq ft (12.1 sq meters).
 - b Attic Areas: 120 sq ft (11.2 sq meters).
 - c Light Hazard Areas: 225 sq ft (20.1 sq meters).
 - III. Design Area shall be hydraulically most remote area in accordance with NFPA 13. a Provide a 10 PSI safety allowance under adjusted water flow supply curve.
 - IV. Maximum velocity of water flow within piping: 20 feet (6.1 m) per sec.
- C. Components:
 - 1. General: Use only domestically manufactured cast iron pipe fittings, valves, sprinkler heads, and other components.
 - I. Pipe of foreign manufacture that meets ASTM Standards is acceptable.
 - II. Ductile iron fittings of foreign manufacture are acceptable.
 - 2. Pipe:
 - I. Schedule 40 Welded Steel:
 - Exterior, Above Ground(if applicable): Schedule 40 hot-dip galvanized welded steel meeting requirements of ASTM A53/A53M, ASTM A135/A135M or ASTM A795/A795M.
 - b Interior, Above Ground: Schedule 40 black welded steel meeting requirements of ASTM A53/A53M, ASTM A135/A135M or ASTM A795/A795M.
 - c Connections:

2 inches (50 mm) And Smaller: Screwed, flanged, or roll grooved coupling system.

2-1/2 inches (64 mm) And Larger: Flanged or roll grooved coupling system.

- 3. Fittings:
 - I. Usage:
 - a 2 inches (50 mm) And Smaller: Welded, screwed, flanged, or roll grooved coupling system. For use with schedule 40 carbon steel pipe.

- b 2-1/2 inches (64 mm) And Larger: Welded, flanged, or roll grooved coupling system.
- II. Types And Quality:
 - a Screwed:
 - Cast iron meeting requirements of ANSI B16.4 or ductile iron meeting requirements of ANSI B16.3 and ASTM A536, Grade 65-45-12. Threaded fittings and pipe shall have threads cut to ANSI B1.20.1.
 - Do not extend pipe into fittings to reduce waterway. Ream pipe after cutting to remove burrs and fins.
 - b Flanged: Steel meeting requirements of ANSI B16.5.
 - c Welded:

Carbon steel meeting requirements of ASTM A234/A234M. Weld pipe using methods complying with AWS B2.1, level AR-3. Welding procedures and performance of welders shall comply with AWS B2.1, level AR3.

d Roll Grooved Pipe Coupling System:

Ductile iron meeting requirements of ASTM A395/A395M and ASTM A536, and UL listed.

Grooved products used on Project shall be from same manufacturer. Grooving tools shall be as recommended by manufacturer of grooved products. Category Four Approved Products: See Section 01 6200 for definition of

Categories:

	Gruvlok	Tyco (Grinnell)	Victaulic
Rigid Couplings	7401	772	Style 005
Flexible Couplings ¹	7000	705	Style 75
Flange Adaptors ²	7012	71	Style 744
Grooved Coupling Gaskets ³	'E' EPDM	Grade 'E' EPDM	'E' EPDM ⁴

¹ Use in locations where vibration attenuation, stress relief, thermal expansion, or seismic design is required / needed.

- ² Class 125 or 150.
- 3 Temperature rated 30 to 150 deg F (minus one to plus 65 deg C). NSF-61 certified.
 - ⁴Grade 'A'.
- III. Use of saddle or hole cut type mechanical tees is **NOT APPROVED**.
- 4. Valves:
 - I. Butterfly Valves:

а

- Design Criteria:
 - UL / CASA approved.
 - Indicating type.
- b Category Four Approved Products: See Section 01 6200 for definitions of Categories:

Milwaukee:

- (1) Model BB-SCS02 threaded ends with tamper switch one inch (25 mm) to 2 inches (50 mm).
- (2) Model BBVSCS02 Grooved ends with tamper switch 2 inches (50 mm) to 2-1/2 inch (64 mm).

Nibco:

- (1) Model WD3510-8 Wafer type with valve tamper switch.
- (2) Model GD4765-8N Grooved type with valve tamper switch, 2-1/2 inches (64 mm) to 8 inches (200 mm).

Tyco (Grinnell):

(1) Model BFV-N wafer.
- (2) Model BFV-N grooved.
- Victaulic: Series 705W Grooved end type with internal supv. switches. Kennedy:
- (1) Model 01W wafer.
- (2) Model G300 grooved.
- II. Gate Valves:

b

- a Design Criteria:
 - UL / CASA approved.
 - Outside Screw and Yoke Type (O.S.&Y).
 - Class 150 psi.
 - Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - Nibco:
 - (1) T-104-0 with Threaded Ends 1/2 inch (12.7 mm) to 2 inches (50 mm).
 - (2) F-637-31 Flanged Ends.
 - Mueller: R-2360-6 Flanged Ends.
 - Victaulic: Series 771 Grooved Ends
- III. Ball Valves:
 - a Design Criteria:
 - UL / CASA approved.
 - Valve tamper switch.
 - b Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - Milwaukee: BB-SCS02 with threaded ends.
 - Nibco: KT-505 with threaded ends.
 - Nibco: KG-505 with grooved ends.
 - Victaulic: Series 728 with grooved or threaded ends.
- IV. Swing Check Valves:
 - a 1/2 to 3 inch (13 to 75 mm) horizontal check.
 - Design Criteria:
 - (1) Regrinding type.
 - (2) Renewable disk.
 - (3) Bronze Class 125 with threaded ends.

Category Four Approved Products: See Section 01 6200 for definitions of Categories:

- (1) Nibco: KT-403-W.
- (2) Victaulic: Series 712.
- (3) Viking: G-1 Grooved ends.
- b 2 to 4 inch (50 to 100 mm) Horizontal check:
 - Design Criteria:
 - (1) Grooved ends.
 - (2) Ductile iron body.
 - (3) Rated 300 psi (2.07 MPa).

Category Four Approved Products: See Section 01 6200 for definitions of Categories:

- (1) Tyco (Grinnell): CV-1F Grooved ends.
- (2) Victaulic: Series 712.
- (3) Viking: G-1 Grooved ends.
- c 3 to 12 inch (76 to 300 mm) Horizontal check:

Design Criteria:

- (1) Bolted bonnet.
- (2) Raised face flanges.
- (3) Bronze mounted with ductile iron body.
- (4) **125 lb** (56.7 kg) Class A.

Category Four Approved Products: See Section 01 6200 for definitions of Categories:

- (1) Nibco: F-938-31.
- (2) Mueller: A-2120-6.
- (3) Viking: F-1 grooved and flanged.
- V. Wafer Type Check Valves:
 - a Design Criteria:
 - 4 to 8 inch (100 to 300 mm) cast iron body.

175 psi (1.21 MPa) minimum working pressure.

- Rubber Seat.
- b Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - Nibco: KW-900-W.
 - Mueller: A-2102.

Kennedy: Fig.706.

- VI. Grooved-End Check Valves:
 - a Design Criteria:
 - UL / CASA listed and approved to 250 psi (1.72 MPa) maximum operating pressure.

2-1/2 to 12 inch (64 to 300 mm) ductile iron body.

- Disc And Seat:
- (1) 2-1/2 And 3 Inch (64 to 75 mm): Aluminum bronze disc with mounted elastomer seal and PPS (polyphenylene sulfide) coated seat.
- (2) 4 Inch (100 mm) And Larger: Elastomer encapsulated ductile iron disc with welded in nickel seat.
- (3) Viking: Model VK462.
- b Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - Nibco: KG-900-W grooved ends.
 - Victaulic: Series 717.
 - Kennedy: Fig.426.
- VII. Alarm Check Valves:
 - a Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - Dalegones.
 - Reliable: E with gauges and drain.
 - Tyco (Grinnell): Model AV-1-300.
 - Victaulic: Series 751 with gauges and drain.
 - Viking: J-1 with gauges and drain.
- VIII. Backflow Preventer: Make and model shown on Drawings or as required by local codes.
- IX. Retard Chamber:
 - a Design Criteria:
 - Self-draining.
 - b Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - Reliable: E-1.
 - Victaulic: Series 752.
 - Viking: C-1.
- X. Inspector's Test Valve:
 - a Design Criteria:
 - Bronze body with threaded or grooved ends.
 - Combination sight glass / orifice.
 - b Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - Tyco (Grinnell): Model F350.
 - Victaulic: Testmaster Alarm Test Module Style 720.
- 5. Sprinkler Heads:

- I. Concealed Pendant:
 - a Design Criteria:
 - Adjustable cover.
 - UL / CASA listed and approved.
 - Coordinate concealed cover finish with Architect.
 - b Type One Acceptable Products:
 - Wet Pendant, Flat Profile:
 - (1) Reliable: F4FR.
 - (2) Victaulic: Model 3802.
 - (3) Viking: Model VK462.
 - (4) Tyco (Grinnell): Model RF11.
 - (5) Equal as approved by Architect before bidding. See Section 01
 - 6200. Dry Pendant:
 - (1) Flat Profile:
 -) Flat Profile:
 - (a) Tyco (Grinnell): DS-C.
 - (b) Victaulic: V3618.
 - (2) Equal as approved by Architect before bidding. See Section 01
 - 6200.
- II. Horizontal Sidewall Sprinkler:
 - a Design Criteria:
 - UL / CASA listed and approved.
 - Recess adjustable.
 - Where guards are required, use chrome plated sprinkler guards that are listed, that are approved by Sprinkler Manufacturer for use with head, and that are supplied by Sprinkler Manufacturer.
 - b Type One Acceptable Products:
 - Wet System:
 - (1) Reliable: F1FR.
 - (2) Tyco (Grinnell): Model TY-FRB.
 - (3) Victualic: Model V2710.
 - (4) Viking: VK305.
 - (5) Equal as approved by Architect before bidding. See Section 01
 - 6200.
 - Dry System:
 - (1) Reliable: F3QR.
 - (2) Tyco (Grinnell): DS-1.
 - (3) Victualic: Model V3610.
 - (4) Viking: VK162.
 - (5) Equal as approved by Architect before bidding. See Section 01
 - 6200.
- III. Attic Sprinklers, Upright:
 - a Design Criteria:
 - UL / CASA listed and approved.
 - Approved for use in roof structures, combustible and non-combustible, with ceiling below.
 - b Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - Tyco: BB, SD, or HIP.
- IV. Pendant Sprinklers:
 - a Design Criteria:
 - UL / CASA listed and approved.

Where guards or escutcheons are required, use chrome plated sprinkler guards and escutcheons that are listed, that are approved by Sprinkler Manufacturer for use with head, and that are supplied by Sprinkler Manufacturer. b Type One Acceptable Products:

Reliable: F1FR.

- Tyco: TY-FRB.
- Victaulic: Model V2704.
- Viking: VK302.
- Equal as approved by Architect before bidding. See Section 01 6200.
- V. Upright Sprinklers:
 - a Design Criteria:
 - UL / CASA listed and approved.
 - b Type One Acceptable Products:
 - Reliable: F1FR.
 - Tyco: TY-FRB.
 - Victaulic: Models V2704.
 - Viking: VK300.
 - Equal as approved by Architect before bidding. See Section 01 6200.
- 6. Water Flow Alarm:
 - I. Electric Flow Alarm:
 - a Design Criteria:
 - UL / CASA listed and approved.
 - b Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - Potter Electric: Horn Strobe, SASH-120, 120VAC.
 - System Sensor: Horn Strobe, P2RHK-120, 120 VAC.
- 7. Waterflow Detectors:
 - I. Electrical Water Flow Switch:
 - a Design Criteria:
 - UL / CASA listed.
 - Switch activates with flow of 10 gpm (37.85 lpm) or more.
 - Two single pole double throw switches.
 - Automatic reset.
 - b Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - Potter-Roemer: Model 6201 thru 6208.
 - System Sensor: WFD20 thru WFD80.
 - Viking: VSR-F.
- 8. Tamper Switch

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- I. Weather and Tamper Resistant Switch.
 - Design Criteria:
 - UL / CASA listed.
 - Mount to monitor valve and not interfere with operation.
 - Shall operate in horizontal and vertical position.
 - b Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - Control Valves, Butterfly Valves, Post Indicator Valves:
 - (1) Potter Electric: Model PCVS.
 - (2) Notifier: Model PIBV2.
 - (3) System Sensor: Model PIBV2.
 - O.S. & Y Valves:
 - (1) Potter Electric: Model OSYSU.
 - (2) System sensor: Model OSY2.
- 9. Automatic Drain Device:
 - I. Design Criteria:
 - a Straight Design, 3/4 inch: (19 mm).
 - Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - a Nibco: Ball-Drip.

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- b Potter-Roemer: Figure 5982.
- c Viking: B-1.
- 10. Fire Department Connection: Contractor shall check with local authority having jurisdiction to confirm the type of FDC required.
 - I. One Way Inlet with 5" Stortzguard Cap:
 - a Class One Quality Standards: See Section 01 6200:
 - Round 'AUTO SPKR' identification plate, red enamel finish aluminum plate:
 - (1) Croker: Fig 6766.
 - (2) Potter-Roemer Fig. 5966.
 - b Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - Rough chrome plated:
 - (1) Croker: 6405-RC.
 - (2) Potter-Roemer: Fig. 5710-C.
 - Caps and Chains:
 - (1) Croker: 6747 RC.
 - (2) Potter-Roemer: 4625.
- 11. Indicating Post Valve:
 - I. Design Criteria:
 - a As specified in Section 33 1119: 'Fire Suppression Water Distribution Piping'.
 - b Prefer exposed parts non-brass, for theft protection.
 - c Supervisory switch.
 - II. Category Four Approved Products: See Section 01 6200 for definitions of Categories: a As required by Authority Having Jurisdiction (AHJ).
- 12. Riser Manifold Assembly:
 - I. Design Criteria:
 - a Groove x Groove Manifold Body.
 - b Water Flow Alarm Switch, VSC with Vane, UL / CASA listed and approved.
 - c 300 psi (2.07 MPa) Water Pressure Gauge.
 - d Test and Drain Valve with Manifold Drain Trim and 1/2 inch (12.7 mm) diameter test Orifice.
 - e Pressure Relief Valve, 175 psi (1.21 MPa), non adjustable, pipe discharge to test Drain Valve.
 - Category Four Approved Products: See Section 01 6200 for definitions of Categories:
 - a Tyco: Model 513.
 - b Victaulic: Style 747P.

2 ACCESSORIES

A. Manufacturers:

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- 1. Manufacturer Contact List:
 - I. Anvil International, Portsmouth, NH www.anvilintl.com.
 - II. Cooper B-Line, Highland, IL www.b-line.com.
- B. Hangers, Rods, And Clamps:
 - 1. Design Criteria:
 - I. Galvanized, unless specified otherwise, and UL / CASA approved for service intended.
 - 2. Class One Quality Standard:
 - I. Hangers and accessories shall be Anvil numbers specified or equals by Cooper B-Line.
 - II. Pipe Ring Hangers: Equal to Anvil Fig 69.

- III. Riser Clamps: Equal to Anvil Fig. 261.
- C. Posted System Diagram:
 - 1. Provide single, color-coded floor plan diagram showing total system. Color antifreeze pipe system elements BLUE and wet pipe system elements RED. Indicate locations of antifreeze system drains and sample test station.
 - 2. Include following information on diagram sheet:
 - I. Explanation of how to test an antifreeze system.
 - II. Step by step shut down procedure.
 - III. Step by step system drainage procedure.
 - IV. Step by step start-up procedure.
 - V. Step by step procedure for protection of system from freezing.
 - 3. Laminate diagram with plastic and mat or frame suitable for hanging near riser.
- **D.** Steel Deck Bracket:
 - 1. Class Two Quality Standard: See Section 01 6200.
 - I. Unistrut P1000 with clamp nut, minimum 6 inch (150 mm) length.

1.3 EXECUTION

1 INSTALLERS

- A. Acceptable Installers. See Section 01 4301:
 - 1. Meet Quality Assurance Installer Qualifications as specified in Part 1 of this specification.

2 EXAMINATION

- A. Drawings:
 - 1. Fire Protection Drawings show general arrangement of piping. Follow as closely as actual building construction and work of other trades will permit. Install system so it drains.
 - Consider Architectural and Structural Drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These Drawings take precedence over Fire Protection Drawings.
 - 3. Because of small scale of Drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions and to enable system to drain.

3 INSTALLATION

- A. Interface With Other Work: Provide inserts for attaching hangers in concrete floor construction at time floors are placed.
- **B.** Connect system to flange provided under Section 33 1119. After installation of riser, fill annular space between pipe and slab with flexible mastic.
- **C.** Install sprinkler systems in accordance with requirements of latest editions of NFPA 13 and as specified below:
 - 1. Provide maintenance access to equipment

- 2. Conceal sprinkler lines installed in occupied areas. In Mezzanine areas, route pipe to side or underneath Mezzanine walkway. Do not impede egress from Attic.
- 3. Install to enable drainage of system.
 - I. Install main drain from riser according to NFPA 13, paragraph 8.17.4.
- 4. Install piping system, except for dry heads, so it will not be exposed to freezing temperatures.
- 5. Do not use dropped, damaged, or used sprinkler heads.
- 6. Install tamper switches and flow detectors where located by Architect.
- 7. Except for Siamese connection, install automatic ball drip device in lowest point of piping to fire department connection and drain to floor drain or to exterior of building.
- 8. Brace and support system to meet seismic zone requirements for building site.
- 9. Inspector's Test and Drain to be placed in a location approved by the architect.
- **D.** Flush system at full design flow rate for minimum five minutes. Route water to outside of building. Protect landscaping and other exterior elements from damage during flow tests.

4 FIELD QUALITY CONTROL

- A. Field Tests:
 - 1. Pressure Test:
 - I. Hydrostatically test system to 200 psi (1.38 MPa) minimum for 2 hours as required by 'Contractor's Material And Testing certificate for Above Ground Piping' NFPA-13.
 - II. If system or part of system is to have a glycol solution, hydrostatic test is to be performed using approved glycol solution. Do not hydrostatically test any section of system that is to be filled with a glycol solution with plain water.
 - 2. Water Flow Test:
 - I. Test to determine static and residual pressures and corresponding flow rate at point of connection to utility water main.
 - II. Adjust water flow test data for seasonal fluctuations and future growth as recommended by Water Utility and AHJ.
 - III. At point of connection to utility water main, combine inside and outside hose stream allowances.
 - 3. Check piping in relation to insulation envelope to be certain piping and auxiliary drains are properly enclosed inside building insulation envelope. Report unsatisfactory conditions to Architect.
 - 4. Tests shall be witnessed by Architect and representative of local jurisdiction over fire prevention.

5 CLOSE-OUT ACTIVITIES

- A. Instruction of Owner:
 - 1. Instruction Sessions:
 - I. Instruct Owner's personnel in operation and maintenance of system utilizing 'Operation And Maintenance Manual' when so doing. Minimum instruction period shall be four (4) hours.
 - a Include antifreeze system requirement to be tested at least once a year.
 - II. Instruction sessions shall occur after Substantial Completion inspection when system is properly working and before final payment is made.
 - III. Provide Owner with latest version of NFPA 25.
- **B.** Training:
 - 1. Installer required to provide FM Training from latest version of NFPA 25 with checklist and brief explanation of following inspections:
 - I. Weekly Inspection.

- II. Monthly Inspection.
- III. Quarterly Inspection.
- IV. Semi-Annual Inspection.
- V. Annual Inspection.

SECTION 22 00 00

SUMMARY OF PLUMBING WORK

PART 1 - GENERAL

- 1.1 WORK COVERED BY CONTRACT DOCUMENTS
 - A. The following Summary of Work is intended as an aid to achieve an understanding of the various elements of work included in the project, as is not intended to be all-inclusive. Detailed descriptions of work and requirements are given in drawings and specifications.
 - B. Plumbing Contract Documents were prepared for the Project by:

Trinity MEP Engineering, LLC 3533 Moreland Dr. Ste. A Weslaco, Texas 78596 Phone Number: (956) 973-0500 Contact Person: Leonardo Munoz, P.E.

- C. General Scope of Work:
 - 1. Install systems and equipment as shown on the contract documents. Refer to drawings for schedule of equipment that will be installed. After installing equipment, connect all water, sewer, and/or power to fixtures.
 - 2. Provide all materials and labor associated with a complete operational installation of new systems including, but not limited to:
 - Fixtures for facility
 - Piping for Sanitary Sewer and Vent Systems
 - Piping for Domestic water and Hot Water Systems.

1.2 COORDINATION

- A. All plumbing work shall be done under sub-contract to a General Contractor. Plumbing Contractor shall coordinate all work through General Contractor, even in areas where only plumbing work is to take place.
- B. Coordination between all trades shall take place on a regular basis to avoid conflicts between disciplines and equipment clearances.
- C. Work shall take place with minimal disruption to Owner's operations in areas surrounding the new building.
- D. Cooperate fully with other contractors so that work under those contracts may be carried out smoothly, without interfering with or delaying work under this Contract.
- E. Fully coordinate with electrical contractor for providing power to plumbing equipment.
- 1.3 UTILITIES
 - 1. Coordinate with power, water, telephone, cable and gas utilities to locate all utilities prior to digging in any area.
 - 2. Obtain any approvals required from utilities to relocate utilities.
 - 3. Cost of relocating or bypassing utilities indicated on drawings shall be included in Base Bid.

1.4 CONTRACTOR USE OF PREMISES

- A. Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.
 - 1. Owner Occupancy: Allow for Owner occupancy and use by the public.
 - 2. Driveways and Entrances: Keep driveways and entrances serving the premises, clear and available to the Owner, the Owner's employees, and emergency vehicles at all time. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- B. Site Safety: Take every precaution to ensure the site does not present a threat to the safety of occupants and/or workers. Minimal safety requirements include, but are not limited to the following:
 - 1. Temporary fencing around construction areas.
 - 2. Yellow caution tape and construction barricades along open trenches during the day. Trenches shall be covered at night and warning lights provided on construction barricades.
 - 3. Temporary fencing around equipment while site work is in progress.
- 1.5 SUBMITTALS
 - 1. All equipment and fixtures shall be provided with a submittal.
 - 2. To extradite the submittal process more efficiently, DO NOT piece-meal the submittals. Submit entire plumbing or in a bound enclosure. This will eliminate delays in the submittal process.

SECTION 22 05 00

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COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Common requirements and procedures for plumbing systems.
 - 2. Responsibility for proper operation of electrically powered equipment furnished under this Division.
 - 3. Furnish and install sealants relating to installation of systems installed under this Division.
 - 4. Furnish and install Firestop Penetration Systems for plumbing systems penetrations as described in Contract Documents.
- B. Products Furnished But Not Installed Under This Section:
 - 1. Sleeves, inserts, supports, and equipment for plumbing systems installed under other Sections.

1.2 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data:
 - a. Manufacturer's catalog data for each manufactured item.
 - Provide section in submittal for each type of item of equipment. Include Manufacturer's catalog data of each manufactured item and enough information to show compliance with Contract Document requirements. Literature shall show capacities and size of equipment used and be marked indicating each specific item with applicable data underlined.
 - 2) Include name, address, and phone number of each supplier.
- B. Informational Submittals:
 - 1. Qualification Statement:
 - a. Plumbing Subcontractor:
 - 1) Provide Qualification documentation if requested by Architect or Owner.
 - b. Installer:

- 1) Provide Qualification documentation if requested by Architect or Owner.
- C. Closeout Submittals:
 - 1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
 - a. Operations and Maintenance Data (Modify and add to requirements of Section 01 7800):
 - 1) At beginning of PLUMBING section of Operations And Maintenance Manual, provide master index showing items included:
 - a) Provide name, address, and phone number of Architect, Architect's Mechanical Engineer, General Contractor, and Plumbing subcontractor.
 - b) Identify maintenance instructions by using same equipment identification used in Contract Drawings. Maintenance instructions shall include:

- List of plumbing equipment used indicating name, model, serial number, and nameplate data of each item together with number and name associated with each system item.
- (2) Manufacturer's maintenance instructions for each piece of plumbing equipment installed in Project. Instructions shall include name of vendor, installation instructions, parts numbers and lists, operation instructions of equipment, and maintenance instructions.
- c) Provide operating instructions to include:
 - (1) General description of fire protection system.
 - (2) Step by step procedure to follow for shutting down system or putting system into operation.
- b. Warranty Documentation:
- 1) Include copies of warranties required in individual Sections of Division 22.

1.3 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
 - 1. Perform work in accordance with applicable provisions of Plumbing Codes applicable to Project. Provide materials and labor necessary to comply with rules, regulations, and ordinances.
 - 2. In case of differences between building codes, laws, local ordinances, utility company regulations, and Contract Documents, the most stringent shall govern. Notify Architect in writing of such differences before performing work affected by such differences.
 - 3. Identification:
 - a. Motor and equipment name plates as well as applicable UL / ULC and AGA / CGA labels shall be in place when Project is turned over to Owner.
- B. Qualifications.
 - 1. Plumbing Subcontractor:
 - a. Company specializing in performing work of this section.
 - 1) Minimum five (5) years experience in plumbing installations.
 - 2) Minimum five (5) satisfactorily completed installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
 - b. Upon request, submit documentation.
 - 2. Installer:
 - a. Licensed for area of Project.
 - b. Designate one (1) individual as project foremen who shall be on site at all times during installation and experienced with installation procedures required for this project.
 - c. Upon request, submit documentation.
- 1.4 DELIVERY, STORAGE, AND HANDLING
 - A. Delivery And Acceptance Requirements:
 - 1. Accept valves on site in shipping containers with labeling in place.
 - 2. Provide temporary protective coating on cast iron and steel valves.
 - 3. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
 - B. Storage And Handling Requirements:
 - 1. In addition to requirements specified within, stored material shall be readily accessible for inspection by Architect/engineer until installed.

2. Store items subject to moisture damage in dry, heated spaces.

1.5 WARRANTY

- A. Manufacturer Warranty:
 - 1. Provide certificates of warranty for each piece of equipment made out in favor of Owner.
- B. Special Warranty:
 - 1. Guarantee plumbing systems to be free from noise in operation that may develop from failure to construct system in accordance with Contract Documents.
 - 2. If plumbing sub-contractor with offices located more than 150 miles (240 km) from Project site is used, provide service / warranty work agreement for warranty period with local plumbing sub-contractor approved by Architect. Include copy of service / warranty agreement in warranty section of Operation And Maintenance Manual.

PART 2 - PRODUCTS

- 2.1 COMPONENTS
 - A. Components shall bear Manufacturer's name and trade name. Equipment and materials of same general type shall be of same make throughout work to provide uniform appearance, operation, and maintenance.
 - B. Pipe And Pipe Fittings:
 - 1. Weld-O-Let and Screw-O-Let fittings are acceptable.
 - 2. Use domestic made pipe and pipe fittings on Project, except non-domestic made cast iron pipe and fittings by MATCO-NORCA are acceptable.
 - C. Sleeves:
 - 1. General:
 - a. Two sizes larger than bare pipe or insulation on insulated pipe.
 - 2. In Concrete And Masonry:
 - a. Sleeves through outside walls, interior shear walls, and footings shall be schedule 80 black steel pipe with welded plate.
 - 3. In Framing And Suspended Floor Slabs:
 - a. Standard weight galvanized iron pipe, Schedule 40 PVC, or 14 ga (2 mm) galvanized sheet metal.
 - D. Valves:
 - 1. Valves of same type shall be of same manufacturer.

PART 3 - EXECUTION

- 3.1 INSTALLERS
 - A. Acceptable Installers:
- 3.2 Meet Quality Assurance Installer Qualifications as specified in Part 1 of this specification.
- 3.3 EXAMINATION
 - A. Drawings:
 - 1. Plumbing Drawings show general arrangement of piping, equipment, etc. Follow as closely as actual building construction and work of other trades will permit.
 - 2. Consider Architectural and Structural Drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These drawings take precedence over Plumbing Drawings.

- 3. Because of small scale of Drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.
- B. Verification Of Conditions:
 - 1. Examine premises to understand conditions that may affect performance of work of this Division before submitting proposals for this work. Examine adjoining work on which plumbing work is dependent for efficiency and report work that requires correction.
 - 2. Ensure that items to be furnished fit space available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents. If approval is received by Addendum or Change Order to use other than originally specified items, be responsible for specified capacities and for ensuring that items to be furnished will fit space available.
 - 3. Check that slots and openings provided under other Divisions through floors, walls, ceilings, and roofs are properly located. Perform cutting and patching caused by neglecting to coordinate with Divisions providing slots and openings at no additional cost to Owner.
- 3.4 No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.
- 3.5 PREPARATION
 - A. Demolition Requirements:
 - B. Changes Due To Equipment Selection:
 - 1. Where equipment specified or otherwise approved requires different arrangement or connections from that shown in Contract Documents, submit drawings showing proposed installations.
 - 2. If proposed changes are approved, install equipment to operate properly and in harmony with intent of Contract Documents. Make incidental changes in piping, ductwork, supports, installation, wiring, heaters, panelboards, and as otherwise necessary.
 - 3. Provide additional motors, valves, controllers, fittings, and other equipment required for proper operation of systems resulting from selection of equipment.
 - 4. Be responsible for proper location of rough-in and connections provided under other Divisions.

3.6 INSTALLATION

- A. Interface With Other Work:
 - 1. Furnish exact location of electrical connections and complete information on motor controls to installer of electrical system.
 - 2. Furnish sleeves, inserts, supports, and equipment that are to be installed by others in sufficient time to be incorporated into construction as work proceeds. Locate these items and confirm that they are properly installed.
 - 3. Furnish inserts for attaching hangers that are to be cast in concrete floor construction at time floors are poured.
- B. Cut carefully to minimize necessity for repairs to previously installed or existing work. Do not cut beams, columns, or trusses.
- C. Locating Equipment:
 - 1. Arrange pipes and equipment to permit ready access to valves, cocks, unions, traps, and to clear openings of doors and access panels.

- 2. Adjust locations of pipes, equipment, and fixtures to accommodate work to interferences anticipated and encountered.
- 3. Install plumbing work to permit removal of equipment and parts of equipment requiring periodic replacement or maintenance without damage to or interference with other parts of equipment or structure.
- 4. Determine exact route and location of each pipe before fabrication.
 - a. Right-Of-Way:
 - 1) Lines that pitch shall have right-of-way over those that do not pitch. For example, plumbing drains shall normally have right-of-way.
 - 2) Lines whose elevations cannot be changed shall have right-of-way over lines whose elevations can be changed.
 - b. Offsets, Transitions, and Changes in Direction:
 - 1) Make offsets, transitions, and changes in direction in pipes as required to maintain proper head room and pitch of sloping lines whether or not indicated on Drawings.
 - 2) Furnish and install all traps, air vents, sanitary vents, and devices as required to effect these offsets, transitions, and changes in direction.
- D. Penetration Firestops:
 - 1. Install Penetration Firestop System appropriate for penetration at plumbing systems penetrations through walls, ceilings, roofs, and top plates of walls.
- E. Sealants:
 - 1. Seal openings through building exterior caused by penetrations of elements of plumbing systems.
 - 2. Furnish and install acoustical sealant to seal penetrations through acoustically insulated walls and ceilings.
- F. Furnish and install complete system of piping, valved as indicated or as necessary to completely control entire apparatus:
 - 1. Pipe drawings are diagrammatic and indicate general location and connections. Piping may have to be offset, lowered, or raised as required or directed at site. This does not relieve this Division from responsibility for proper installation of plumbing systems.
 - 2. Arrange piping to not interfere with removal of other equipment, ducts, or devices, or block access to doors, windows, or access openings:
 - a. Arrange so as to facilitate removal of tube bundles.
 - b. Provide accessible flanges or ground joint unions, as applicable for type of piping specified, at connections to equipment and on bypasses.
 - 1) Make connections of dissimilar metals with di-electric unions.
 - 2) Install valves and unions ahead of traps and strainers. Provide unions on both sides of traps.
 - c. Do not use reducing bushings, bull head tees, close nipples, or running couplings. Street elbows are allowed only on potable water pipe 3/4 inch (19 mm) in diameter and smaller.
 - d. Install piping systems so they may be easily drained
 - e. Install piping to insure noiseless circulation.
 - f. Place valves and specialties to permit easy operation and access. Valves shall be regulated, packed, and glands adjusted at completion of work before final acceptance.
 - 3. Do not install piping in shear walls.
 - 4. Cut piping accurately to measurements established at site. Remove burr and cutting slag from pipes.

- 5. Work piping into place without springing or forcing. Make piping connections to pumps and other equipment without strain at piping connection. Remove bolts in flanged connections or disconnect piping to demonstrate that piping has been so connected, if requested.
- 6. Make changes in direction with proper fittings.
- 7. Expansion of Thermoplastic Pipe:
 - a. Provide for expansion in every 30 feet of straight run.
 - b. Provide 12 inch offset below roof line in each vent line penetrating roof.
- 8. Expansion of PEX Pipe: Allow for expansion and contraction of PEX pipe as recommended by Pipe Manufacturer.
- G. Sleeves:
 - 1. Do not place sleeves around soil, waste, vent, or roof drain lines passing through concrete slabs on grade (unless noted on plans).
 - Provide sleeves around pipes passing through concrete or masonry floors, walls, partitions, or structural members. Seal sleeves with specified sealants. Follow Pipe Manufacturer's recommendations for PEX pipe (if used) penetrations through studs and floor slabs.
 - 3. Sleeves through floors shall extend 1/4 inch above floor finish in mechanical equipment rooms above basement floor. In other rooms, sleeves shall be flush with floor.
 - 4. Sleeves through floors and foundation walls shall be watertight.
- H. Escutcheons:
 - 1. Provide spring clamp plates where pipes run through walls, floors, or ceilings and are exposed in finished locations of building. Plates shall be chrome plated heavy brass of plain pattern and shall be set tight on pipe and to building surface.
- 3.7 REPAIR / RESTORATION
 - A. Each Section of this Division shall bear expense of cutting, patching, repairing, and replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it:
 - 1. Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown.
 - 2. Surface finishes shall exactly match existing finishes of same materials.
- 3.8 FIELD QUALITY CONTROL
 - A. Field Tests:
 - 1. Perform tests on plumbing piping systems. Furnish devices required for testing purposes.
 - B. Non-Conforming Work:
 - 1. Replace material or workmanship proven defective with sound material at no additional cost to Owner.
 - 2. Repeat tests on new material, if requested.
- 3.9 CLEANING
 - A. Remove dirt, grease, and other foreign matter from each length of piping before installation:
 - 1. After each section of piping used for movement of water or steam is installed, flush with clean water, except where specified otherwise.
 - 2. Arrange temporary flushing connections for each section of piping and arrange for flushing total piping system.
 - 3. Provide temporary cross connections and water supply for flushing and drainage and remove after completion of work.

B. Clean exposed piping, equipment, and fixtures. Remove stickers from fixtures and adjust flush valves. 3.10 CLOSEOUT ACTIVITIES

- A. Instruction of Owner:
 - 1. Instruct building maintenance personnel in operation and maintenance of plumbing systems utilizing Operation And Maintenance Manual when so doing.
 - 2. Conduct instruction period after Substantial Completion inspection when systems are properly working and before final payment is made.

3.11 PROTECTION

A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system. Cap or plug open ends of pipes and equipment to keep dirt and other foreign materials out of system. Do not use plugs of rags, wool, cotton waste, or similar materials.

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Common hanger and support requirements and procedures for plumbing systems.
- B. Products Installed But Not Furnished Under This Section:
 - 1. Paint identification for gas piping used in HVAC equipment.
- 1.2 SUBMITTALS
 - A. Action Submittals:
 - 1. Product Data:
 - a. Manufacturer's catalog data for each manufactured item.

PART 2 - PRODUCTS

- 2.1 ASSEMBLIES
 - A. Manufacturers:
 - 1. Manufacturer Contact List:
 - a. Anvil International,
 - b. Cooper B-Line,
 - c. Unistrut, Wayne,
 - B. Materials:
 - 1. Hangers, Rods, And Inserts
 - a. Galvanized and UL approved for service intended.
 - b. Support horizontal piping from hangers or on roller assemblies with channel supports, except where trapeze type hangers are explicitly shown on Drawings. Hangers shall have double nuts.
 - 1) Support insulated pipes 2 inches in diameter and smaller with adjustable swivel ring hanger with insulation protection shield. Gauge and length of shield shall be in accordance with Anvil design data.
 - 2) Type Two Acceptable Products:
 - (1) Swivel Ring Hanger: Anvil Fig. 69.
 - (2) Insulation Protection Shield: Anvil Fig. 167.

- (3) Equals by Cooper B-Line.
- 3) Support insulated pipes 2-1/2 inches in diameter and larger with clevis hanger or roller assembly with an insulation protection shield. Gauge and length of shield shall be according to Anvil design data.
 - a) Type Two Acceptable Products:
 - (1) Clevis Hanger: Anvil Fig. 260.
 - (2) Roller Assembly: Anvil Fig. 171.
 - (3) Insulation Protection Shield: Anvil Fig. 167.
 - (4) Equals by Cooper B-Line.
 - 4) Support uninsulated copper pipe 2 inches in diameter and smaller from swivel ring hanger, copper plated and otherwise fully suitable for use with copper tubing. Support non-copper uninsulated pipes from swivel ring hanger.
 - a) Type Two Acceptable Products:
 - (1) Swivel Ring Hanger For Copper Pipe: Anvil Fig. CT-69.
 - (2) Swivel Ring Hanger For Other Pipe: Anvil Fig. 69.
 - (3) Equals by Cooper B-Line.

- 5) Support uninsulated copper pipe 2-1/2 inches in diameter and larger from clevis hanger, copper plated hangers and otherwise fully suitable for use with copper tubing. Support non-copper uninsulated pipes from clevis hanger.
 - a) Type Two Acceptable Products:
 - (1) Clevis Hanger For Copper Pipe: Anvil Fig. CT-65.
 - (2) Clevis Hanger For Other Pipe: Anvil Fig. 260.
 - (3) Equals by Cooper B-Line.

c. Support rods for single pipe shall be in accordance with following table:

Rod Diameter	Pipe Size
3/8 inch	2 inches and smaller
1/2 inch	2-1/2 to 3-1/2 inches
5/8 inch	4 to 5 inches
3/4 inch	6 inches
7/8 inch	8 to 12 inches

d. Support rods for multiple pipe supported on steel angle trapeze hangers shall be in accordance with following table:

R	ods	Number of Pipes per Hanger for Each Pipe Size							
Number	Diameter	2 Inch	2.5	3	4	5	6	8	
			Inch	Inch	Inch	Inch	Inch	Inch	
2	3/8 Inch	Two	0	0	0	0	0	0	
2	1/2 Inch	Three	Three	Two	0	0	0	0	
2	5/8 Inch	Six	Four	Three	Two	0	0	0	
2	5/8 Inch	Nine	Seven	Five	Three	Two	Two	0	
2	5/8 Inch	Twelve	Nine	Seven	Five	Three	Two	Two	

- 1) Size trapeze angles so bending stress is less than 10,000 psi
- e. Riser Clamps For Vertical Piping:
 - 1) Type Two Acceptable Products:
 - a) Anvil Fig. 261.
 - b) Equals by Cooper B-Line.
- f. Concrete Inserts:
 - 1) Individual Inserts:
 - a) Suitable for special nuts size 3/8 inch through 7/8 inch with yoke to receive concrete reinforcing rods, and with malleable iron lugs for attaching to forms.
 - b) Type Two Acceptable Products:
 - (1) Anvil Fig. 282.
 - (2) Equals by Cooper B-Line.
 - 2) Continuous Inserts:
 - a) Class Two Quality Standard: Equal to Unistrut P-3200 series.

- g. Steel Deck Bracket:
 - 1) Class Two Quality Standard: Equal to Unistrut P1000 with clamp nut, minimum 6 inch length.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Interface With Other Work: If project contains concrete structural system.
 - 1. Furnish inserts for attaching hangers that are to be cast in concrete floor construction at time floors are poured.
 - B. Piping:
 - 1. Properly support piping and make adequate provisions for expansion, contraction, slope, and anchorage.
 - a. Except for underground pipe, suspend piping from roof trusses or clamp to vertical walls using Unistrut and clamps. Do not hang pipe from other pipe, equipment, or ductwork. Laying of piping on any building element is not allowed.
 - b. Supports For Horizontal Piping:
 - 1) Support metal piping at 96 inches on center maximum for pipe 1-1/4 inches or larger and 72 inches on center maximum for pipe 1-1/8 inch or less.
 - 2) Support thermoplastic pipe at 48 inches on center maximum.
 - 3) Support PEX pipe at 32 inches minimum on center.
 - 4) Provide support at each elbow. Install additional support as required.
 - c. Supports for Vertical Piping:
 - 1) Place riser clamps at each floor or ceiling level.
 - 2) Securely support clamps by structural members, which in turn are supported directly from building structure.
 - 3) Provide clamps as necessary to brace pipe to wall.
 - d. If Structural concrete systems are used: Install supports from inserts cast into concrete floor system, including concrete joists and floor slabs. Where inserts cannot be used, provide expansion shields and support hangers from angles held in place by expansion bolts, never directly from expansion bolt itself. Provide calculations necessary to determine number of expansion bolts required to equal capacity of cast-in-place insert.
 - e. Attach Unistrut to structural steel roof supporting structure. Spacing and support as described above.
 - f. Insulate hangers for copper pipe from piping by means of at least two layers of Scotch 33 plastic tape.
 - 2. Gas piping Identification:
 - a. Apply paint identification for gas piping used with HVAC equipment as specified in Section 23 0553.

SECTION 22 05 53

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IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

- 1.1 SUMMARY
 - A. Includes But Not Limited To:

1. Furnish and install identification of plumbing piping and equipment as described in Contract Documents.

PART 2 - PRODUCTS

- 2.1 SYSTEM
 - A. Materials:
 - 1. Labels:
 - a. Equipment Identification:
 - 1) Black formica, with white reveal when engraved.
 - 2) Lettering to be 3/16 inch high minimum.
 - 2. Paint:
 - a. One Coat Primer:
 - 1) 6-2 Quick Drying Latex Primer Sealer over fabric covers.
 - 2) 6-205 Metal Primer under dark color paint.
 - 3) 6-6 Metal Primer under light color paint.
 - b. Finish Coats: Two coats 53 Line Acrylic Enamel.
 - c. Type Two Acceptable Products.
 - 1) Paint of equal quality from following Manufacturers may be submitted for Architect's approval before use. Maintain specified colors, shades, and contrasts.
 - a) Benjamin Moore,
 - b) ICI Dulux,
 - c) Sherwin Williams,

PART 3 - EXECUTION

3.1 APPLICATION

- A. Labels:
 - 1. Identify following items with specified labels fastened to equipment with screws (unless noted otherwise):
 - 2. Water Heaters.
 - 3. Engrave following data from Equipment Schedules on Drawings onto labels:
 - a. Equipment mark.
 - b. Room(s) served.
 - c. Panel and breaker from which unit is powered.
- B. Painting:
 - 1. Only painted legends, directional arrows, and color bands are acceptable.
 - 2. Locate identifying legends, directional arrows, and color bands at following points on exposed piping of each piping system:
 - a. Adjacent to each item of equipment.
 - b. At point of entry and exit where piping goes through wall.

- c. On each riser and junction.
- d. Every 25 feet on long continuous lines.
- e. Stenciled symbols shall be one inch high and black.

3.2 ATTACHMENTS

- A. Schedules:
 - 1. Pipe Identification Schedule:
 - a. Apply stenciled symbols as follows:

Pipe Use	Abbreviation
Domestic Cold Water	CW
Domestic Hot Water	НW

SECTION 22 07 19

PLUMBING PIPING INSULATION

PART1- GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Furnish and install insulation on hot and cold water lines, fittings, valves, and accessories as described in Contract Documents.
 - 2. Furnish and install insulation on roof drain piping as described in Contract Documents.
- B. Related Requirements:
 - 1. Section 22 1116: 'Domestic Water Piping'.
 - 2. Section 22 1400: 'Facility Storm Drainage'. (if provided on plans)
- 1.2 SUBMITTALS
 - A. Informational Submittals:
 - 1. Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
- 1.3 QUALITY ASSURANCE
 - A. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.
- 1.4 DELIVERY, STORAGE, AND HANDLING
 - A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

Service Water Temperature	Pipe Sizes					
	Up to 1-1/4 In 1-1/2 to 2	In Over 2 In				
170 - 180 Deg F	One In	1-1/2 In	2 In			
140 - 160 Deg F	1/2 In	One In	1-1/2 ln			
45 - 130 Deg F	1/2 In	1/2 In	One In			

1.5 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified Section "Hangers and Supports."
- B. Coordinate clearance requirements with piping Installer for insulation application.
- C. Coordinate installation and testing of steam or electric heat tracing.

1.6 SCHEDULING

A. Schedule insulation application after testing piping systems and, where required, after installing and testing heat-trace tape. Insulation application may begin on segments of piping that have satisfactory test results.

PART 2 - PRODUCTS

- 2.1 COMPONENTS
 - A. Manufacturers:
 - 1. Manufacturer Contact List:
 - a. Armacell, Mebane, NC www.armaflex.com.
 - b. Childers Products Co, Eastlake, OH www.fosterproducts.com.
 - c. IMCOA, Youngsville, NC www.nomacokflex.com.
 - d. Johns-Manville, Denver, CO www.jm.com.
 - e. Knauf, Shelbyville, IN www.knauffiberglass.com.
 - f. Manson, Brossard, PQ, Canada www.isolationmanson.com.
 - g. Nomaco Inc, Yopungsville, NC www.nomacokflex.com.
 - h. Owens-Corning, Toledo, OH www.owenscorning.com.
 - i. Speedline Corp, Solon, OH www.speedlinepvc.com.
 - j. CertainTeed Manson.
 - k. Knauf FiberGlass GmbH.
 - I. Owens-Corning Fiberglas Corp.
 - m. Schuller International, Inc.
 - n. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
 - o. Armstrong World Industries, Inc.
 - p. Rubatex Corp.
 - B. Materials:
 - 1. Above Grade Metal Piping:
 - a. Insulation For Piping:
 - 1) Snap-on glass fiber or melamine foam pipe insulation, or heavy density pipe insulation with factory vapor jacket.
 - 2) Insulation Thickness:
 - 3) Performance Standards: Fiberglas ASJ by Owens-Corning.
 - 4) Type One Acceptable Manufacturers:
 - a) Childers Products.
 - b) Knauf.
 - c) Manson.
 - d) Owens-Corning.
 - e) Johns-Manville.
 - f) Equal as approved by Architect before bidding. See Section 01 6200.
 - b. Fitting, Valve, And Accessory Covers:
 - 1) PVC.
 - 2) Performance Standard: Zeston by Johns-Manville.
 - 3) Type One Acceptable Manufacturers:

- a) Knauf.
- b) Speedline.
- c) Johns-Manville.
- d) Equal as approved by Architect before bidding. See Section 01 6200.
- 2. Below Grade Metal Piping:
 - a. Insulation:
 - 1) 1/2 inch (13 mm) thick.
 - 2) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) SS Tubolit by Armacell.
 - b) ImcoLock by Imcoa.
 - c) Nomalock or Therma-Cel by Nomaco.
 - b. Joint Sealant:
 - 1) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) Armacell 520.
 - b) Nomaco K-Flex R-373.
- 3. Pex Piping, Above And Below Grade:
 - a. Insulation:
 - 1) 1/2 inch (13 mm) thick.
 - 2) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) SS Tubolit
 - b) by Armacell.
 - c) ImcoLock by Imcoa.
 - d) Nomalock or Therma-Cel by Nomaco.
 - b. Joint Sealant:
 - 1) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) Armacell 520.
 - b) Nomaco K-Flex R-373.
 - c)
- 4. PP-R Piping, Above And Below Grade:
 - a. Insulation:
 - 1) 1/2 inch (13 mm) thick.
 - 2) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) SS Tubolit by Armacell.
 - b) ImcoLock by Imcoa.
 - c) Nomalock or Therma-Cel by Nomaco.
 - b. Joint Sealant:
 - 1) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) Armacell 520.
 - b) Nomaco K-Flex R-373.
- 5. PVC or ABS Piping, Above And Below Grade Facility Storm Drain:
 - a. Insulation:
 - 1) 1/2 inch (13 mm) thick.
 - 2) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) SS Tubolit by Armacell.

- b) ImcoLock by Imcoa.
- c) Nomalock or Therma-Cel by Nomaco.
- b. Joint Sealant:
 - 1) Category Four Acceptable Products. See Section 01 6200 for definition of Categories:
 - a) Armacell 520.
 - b) Nomaco K-Flex R-373.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Above Grade Piping:
 - 1. Apply insulation to clean, dry piping with joints tightly butted.
 - 2. Install insulation in manner to facilitate removal for repairs. Place sections or blocks so least possible damage to insulation will result from inspection or repairs of piping or equipment.
 - 3. Piping up to 1-1/4 inch Diameter:
 - a. Adhere 'factory applied vapor barrier jacket lap' smoothly and securely at longitudinal laps with white vapor barrier adhesive.
 - b. Adhere 3 inch wide self-sealing butt joint strips over end joints.
 - 4. Piping 1-1/2 inches Diameter And Larger:
 - a. Use broken-joint construction in application of two-layer covering.
 - b. Fill cracks and depressions with insulating cement mixed to thick plastic paste.
 - 1) Apply by hand in several layers to make up total specified thickness.
 - 2) Final layer shall have smooth uniform finish before application of covering.
 - 5. Fittings, Valves, And Accessories:
 - a. Do not apply insulation over flanged joints or victaulic couplings until piping has been brought up to operating temperature and flange bolts have been fully tightened. Insulate valves so wheel, stem, and packing nut are exposed.
 - b. Insulate with same type and thickness of insulation as pipe, with ends of insulation tucked snugly into throat of fitting and edges adjacent to pipe insulation tufted and tucked in.
 - c. Piping Up To 1-1/4 Inch Diameter:
 - 1) Cover insulation with one piece fitting cover secured by stapling or taping ends to adjacent pipe covering.
 - 2) Alternate Method:
 - a) Insulate fittings, valves, and accessories with one inch of insulating cement and vapor seal with two 1/8 inch wet coats of vapor barrier mastic reinforced with glass fabric extending 2 inches onto adjacent insulation.
 - d. Piping 1-1/2 inches To 2 Inches :
 - 1) Insulate with hydraulic setting insulating cement or equal, to thickness equal to adjoining pipe insulation.
 - 2) Apply final coat of fitting mastic over insulating cement.
 - e. Piping 2-1/2 inch And Larger:
 - 1) Insulate with segments of molded insulation securely wired in place and coated with skim coat of insulating cement.
 - 2) Apply fitting mastic, fitting tape and finish with final coat of fitting mastic.
 - 6. Pipe Hangers:
 - a. Do not allow pipes to come in contact with hangers.

- b. Pipe Shield:
 - 1) Provide schedule 40 PVC by 6 inch ong at each clevis and/or unistrut type hanger.
 - 2) Provide 16 ga by 6 inch long galvanized shields at each pipe hanger to protect pipe insulation from crushing by clevis hanger.
 - 3) Provide 22 ga by 6 inch long galvanized shield at each pipe hanger to protect insulation from crushing by Unistrut type hanger.
- c. At Pipe Hangers:
 - 1) Provide rigid calcium silicate insulation (100 psi compressive strength) at least 2 inches beyond shield.
- 7. Protect insulation wherever leak from valve stem or other source might drip on insulated surface, with aluminum cover or shield rolled up at edges and sufficiently large in area and of shape that dripping will not splash on surrounding insulation.
- B. Below Grade Piping:
 - 1. Slip underground pipe insulation onto pipe and seal butt joints.
 - 2. Where slip-on technique is not possible, slit insulation, apply to pipe, and seal seams and joints.
- 3.2 EXAMINATION
 - A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 - B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

- A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.
- 3.4 GENERAL APPLICATION REQUIREMENTS
 - A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
 - B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.
 - C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
 - D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.
 - E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
 - F. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
 - G. Keep insulation materials dry during application and finishing.
 - H. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
 - I. Apply insulation with the least number of joints practical.
 - J. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.
 - K. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
 - 1. Apply insulation continuously through hangers and around anchor attachments. Insulation around hanger or pipe clamp will not be acceptable.

- 2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches (300 mm) from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- 3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
- 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.
- L. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- M. Apply adhesives and mastics at the manufacturer's recommended coverage rate.
- N. Apply insulation with integral jackets as follows:
 - 1. Pull jacket tight and smooth.
 - Circumferential Joints: Cover with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches (100 mm) o.c.
 - 3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches (40 mm). Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches (100 mm) o.c.
 - a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.
 - 4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
 - 5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vaporretarder mastic.
- O. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
 - 1. Seal penetrations with vapor-retarder mastic.
 - 2. Apply insulation for exterior applications tightly joined to interior insulation ends.
 - 3. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
 - 4. Seal metal jacket to roof flashing with vapor-retarder mastic.
- P. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.
- Q. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.
- R. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of firerated walls and partitions.
 - 1. Firestopping and fire-resistive joint sealers are specified in Section "Firestopping."
- 3.5 MINERAL-FIBER INSULATION APPLICATION
 - A. Apply insulation to straight pipes and tubes as follows:
 - 1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
 - 2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet (4.5 to 6 m) to form a vapor retarder between pipe insulation segments.

- 3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
- 4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
- 3.6 Apply insulation to flanges as follows:
 - 1. Apply preformed pipe insulation to outer diameter of pipe flange.
 - 2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
 - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
 - 4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch (25 mm), and seal joints with vapor-retarder mastic.
 - B. Apply insulation to fittings and elbows as follows:
 - 1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 - 2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
 - 3. Cover fittings with standard PVC fitting covers.
 - C. Apply insulation to valves and specialties as follows:
 - Apply premolded segments of cellular-glass insulation or glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to strainer basket without disturbing insulation.
 - 2. Apply insulation to flanges as specified for flange insulation application.
 - 3. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
 - 4. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.7 CLOSED-CELL PHENOLIC-FOAM INSUALTION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:
 - 1. Secure each layer of insulation to pipe with wire, tape, or bands without deforming insulation materials.
 - 2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic.
 - 3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches o.c.
 - 4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
- B. Apply insulation to flanges as follows:
 - 1. Apply preformed pipe insulation to outer diameter of pipe flange.
 - 2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.

- 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of the same thickness as pipe insulation.
- 4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch (25 mm), and seal joints with vapor-retarder mastic.
- C. Apply insulation to fittings and elbows as follows:
 - 1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturers written instructions.
 - 2. When premolded sections of insulation are not available, apply mitered sections of phenolic-foam insulation. Secure insulation materials with wire, tape, or bands.
 - 3. Cover fittings with heavy PVC fitting covers. Overlap PVC covers on pipe insulation jackets at least 1 inch (25 mm) at each end. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
- D. Apply insulation to valves and specialties as follows:
 - 1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
 - 2. When premolded sections of insulation are not available, apply mitered sections of phenolic-foam insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to stainer basket without distributing insulation.
 - 3. Apply insulation to flanges as specified for flange insulation application.
 - 4. Use preformed heavy PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
 - 5. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.8 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:
 - 1. Follow manufacturer's written instructions for applying insulation.
 - 2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- B. Apply insulation to flanges as follows:
 - 1. Apply pipe insulation to outer diameter of pipe flange.
 - 2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
 - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of the same thickness as pipe insulation.
 - 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- C. Apply insulation to fittings and elbows as follows:
 - 1. Apply mitered sections of pipe insulation.
 - 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- D. Apply insulation to valves and specialties as follows:

- 1. Apply preformed valve covers manufactured of the same material as pipe insulation and attached according to the manufacturer's written instructions.
- 2. Apply cut segments of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, fabricate removable sections of insulation arranged to allow access to stainer basket.
- 3. Apply insulation to flanges as specified for flange insulation application.
- 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

3.9 FIELD-APPLIED JACKET APPLICATION

- A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.
 - 1. Apply jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
 - 2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of jacket manufacturer's recommended adhesive.
 - 3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.
- B. Foil and Paper Jackets: Apply foil and paper jackets where indicated.
 - 1. Draw jacket material smooth and tight.
 - 2. Apply lap or joint strips with the same material as jacket.
 - 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 - 4. Apply jackets with 1-1/2-inch (40-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
 - 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-retarder mastic.
- C. Apply metal jacket where indicated, with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.10 PIPING SYSTEM APPLICATIONS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.
- B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
 - 1. Flexible connectors.
 - 2. Fire-suppression piping.
 - 3. Drainage piping located in crawl spaces, unless otherwise indicated.
 - 4. Below-grade piping, unless otherwise indicated.
 - 5. Chrome-plated pipes and fittings, unless potential for personnel injury.
 - 6. Air chambers, unions, strainers, check valves, plug valves, and flow regulators.

3.11 INTERIOR INSULATION APPLICATION SCHEDULE

- A. Service: Domestic water piping.
 - 1. Operating Temperature: 60 to 80 deg F
 - 2. Insulation Material: Mineral Fiber
 - 3. Insulation Thickness: 1" thick.
 - 4. Field-Applied Jacket: Foil and Paper(ASJ)
 - 5. Vapor Retarder Required: Yes.

- 6. Finish: None.
- B. Service: Domestic hot and recirculated hot water.
 - 1. Operating Temperature: 60 to 140 deg F (15 to 60 deg C).
 - 2. Insulation Material: Mineral fiber
 - 3. Insulation Thickness: 1" thick
 - 4. Field-Applied Jacket: Foil and Paper(ASJ)
 - 5. Vapor Retarder Required: No
 - 6. Finish: None.
- C. Service: Condensate and equipment drain piping.
 - 1. Operating Temperature: 40 to 60 deg F
 - 2. Insulation Material: Flexible elastomeric, only on first ten feet of pipe from trap.
 - 3. Insulation Thickness: 3/4"
 - 4. Field-Applied Jacket: None.
 - 5. Vapor Retarder Required: No.
 - 6. Finish: Two coats of the insulation manufacturer's recommended protective coating.
- D. Service: Refrigerant suction and hot-gas piping.
 - 1. Operating Temperature: 35 to 50 deg F
 - 2. Insulation Material: Flexible elastomeric.
 - 3. Insulation Thickness: 1" thick.
 - 4. Field-Applied Jacket: Aluminum Jacket on building exterior application only.
 - 5. Vapor Retarder Required: Yes.
 - 6. Finish: None.
- E. Service: For obtaining fire/smoke rating in return air plenum (calbes, PE, PB, PP, ABS, PVC, CPVC, etc).
 - 1. Operating Temperature: 35 to 90 deg F
 - 2. Insulation Material: 3M Fire Barrier Plenum Wrap 5 A or equal.
 - 3. Insulation Thickness: larger of 1" or mfr's recommendations.
 - 4. Field-Applied Jacket: scrim reinforced foil
 - 5. Vapor Retarder Required: None.
 - 6. Finish: None.

3.12 EXTERIOR INSULATION APPLICATION SCHEDULE

- A. Service: Domestic water.
 - 1. Operating Temperature: 60 to 140 deg F (15 to 60 deg C).
 - 2. Insulation Material: Mineral fiber.
 - 3. Insulation Thickness: Apply the following insulation thicknesses: 1"
 - 4. Field-Applied Jacket: Aluminum.
 - 5. Vapor Retarder Required: Yes.
 - 6. Finish: None.
- B. Service: Refrigerant suction.
 - 1. Operating Temperature: 35 to 50 deg F (2 to 10 deg C).
 - 2. Insulation Material: Flexible elastomeric.
 - 3. Insulation Thickness: Apply the following insulation thicknesses: $\frac{1}{2}$ "
 - 4. Field-Applied Jacket: Aluminum

- 5. Vapor Retarder Required: Yes.
- 6. Finish: None.
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SECTION 22 11 16

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

- B. Includes But Not Limited To:
 - 1. Perform excavating and backfilling required by work of this Section.
 - 2. Furnish and install potable water piping complete with necessary valves, connections, and accessories inside building and connect with outside utility lines 5 feet from building perimeter as described in Contract Documents.
- 1.2 PERFORMANCE REQUIREMENTS
 - A. Provide components and installation capable of producing domestic water piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Domestic Water Distribution Piping: 125 psig..

1.3 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: For pipe, tube, fittings, and couplings.
 - 2. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- B. Informational Submittals:
 - 1. Test And Evaluation Reports:
 - b. Written report of sterilization test.
- C. Shop Drawings:
 - b. Piping Layout:
 - 1) Provide as-built drawings at end of project.

1.4 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
 - 1. Meet NSF International Standards for materials or products that come into contact with drinking water, drinking water treatment chemicals, or both for chemical contaminants and impurities that are indirectly imparted to drinking water from products, components, and materials used in drinking water systems.
 - 2. California only: California Assembly Bill 1953 (AB1953) Compliant for Lead Free.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic, potable domestic water piping and components.
- D. Comply with NSF 61, "Drinking Water System Components-Health Effects; Sections 1 through 9," for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 SYSTEMS

- A. Manufacturers:
 - 1. Manufacturer Contact List:
 - b. Aquatherm, Inc.,
 - c. Cash Acme,
 - d. Cla-Val Company,
 - e. Conbraco Industries Inc,
 - f. Hammond Valve,
 - g. Handy & Harmon Products Div,
 - h. Honeywell Inc,
 - i. Leonard Valve Co,
 - j. Milwaukee Valve Co,
 - k. Nibco Inc,
 - l. Rehau,
 - m. Sloan Valve Co,
 - n. Spence Engineering Co,
 - o. Symmons Industries, Braintree,
 - p. Uponor Inc,
 - q. Viega ProPress, Wic
 - r. Watts Regulator Co,
 - s. Wilkins (Zurn Wilkins),
 - t. Zurn PEX, Inc.

B. Materials:

- 1. Design Criteria:
 - b. All drinking water products, components, and materials above and below grade used in drinking water systems must meet NSF International Standards for Lead Free.
 - c. No CPVC allowed.
- 2. Pipe:
 - b. Copper:
 - 3) Above-Grade:
 - a) Meet requirements of ASTM B88, Type K & L.
 - b) Hard Copper Tube: ASTM B 88, Types K and L, water tube, drawn tempered.
 - c) Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

- d) Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
- e) Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with balland-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- f)Copper, Grooved-End Fittings: ASTM B 75 (ASTM B 75M) copper tube or ASTM B 584 bronze castings.
- g) Copper-Tubing, Keyed Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for hot water, and bolts and nuts.
- 4) Below-Grade:
 - a) Meet requirements of ASTM B88, Type K. 3/4 inch minimum under slabs.
 - b) 2 inches And Smaller: Annealed soft drawn.
 - c) 2-1/2 inches And Larger: Hard Drawn.
- 5) Fittings:
 - a) For Copper Pipe: Wrought copper.
- 3. Connections For Copper Pipe:
 - b. Above-Grade:
 - Sweat copper type with 95/5 or 96/4 Tin-Antimony solder, Bridgit solder, or Silvabrite 100 solder. Use only lead-free solder.
 - 4) Viega ProPress System
 - c. Below Grade:
 - 3) Brazed using following type rods:
 - a) Copper to Copper Connections:
 - 2) AWS Classification BCuP-4 Copper Phosphorus (6 percent silver).
 - 3) AWS Classification BCuP-5 Copper Phosphorus (15 percent silver).
 - 4) Copper to Brass or Copper to Steel Connections: AWS Classification BAg-5 Silver (45 percent silver).
 - 5) Do not use rods containing Cadmium.
 - 6) Brazing Flux:
 - a) Approved Products:
 - 1) Stay-Silv white brazing flux by Harris Product Group.
 - 2) High quality silver solder flux by Handy & Harmon.
 - 7) Joints under slabs acceptable only if allowed by local codes.
- 4. Ball Valves:
 - b. Use ball valves exclusively unless otherwise specified. Ball valves shall be by single manufacturer from approved list below.
 - c. Valves shall be two-piece, full port for 150 psi SWP.
 - 3) Operate with flow in either direction, suitable for throttling and tight shut-off.
 - 4) Body: Bronze, 150 psig wsp at 350 deg F and 400 psig wog.
 - 5) Seat: Bubble tight at 100 psig under water.
 - d. Class One Quality Standard: Nibco T585 or S585.
 - 3) Equal by Conbraco 'Apollo,' Hammond, Milwaukee, or Watts.

- 5. Combination Pressure Reducing Valve / Strainer:
 - b. Integral stainless steel strainer, or separate 'Y' strainer installed upstream of pressure reducing valve.
 - c. Built-in thermal expansion bypass check valve.
 - d. Class One Quality Standard: Watts LFU5B:
 - 3) Equal by Cash Acme, Cla-Val Hi Capacity, Conbraco 36C, Honeywell-Braukmann, Spence Hi Capacity, Watts, or Wilkins. See Section 01 6200.

PART 3 - EXECUTION

- 3.1 INSTALLATION
 - A. Below Grade:
 - 1. Install piping under slabs without joints where possible.
 - 2. Insulate water piping buried within building perimeter.
 - 3. Bury water piping 6 inches minimum below bottom of slab and encase in 2 inches minimum of sand.
 - B. Locate cold water lines a minimum of 6 inches from hot water line.

3.2 FIELD QUALITY CONTROL

- A. Field Tests:
 - 1. Before pipes are covered, test systems in presence of Architect/Engineer at 125 psig hydrostatic pressure for four (4) hours and show no leaks.
 - 2. Disconnect equipment not suitable for 125 psig pressure from piping system during test period.

3.3 ADJUSTING

- A. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - 1. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
 - 2. Adjust calibrated balancing valves to flows indicated.

3.4 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:
 - b. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - c. Fill and isolate system according to either of the following:
 - Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.

- 4) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
- d. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
- e. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Prepare and submit reports of purging and disinfecting activities.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.
- D. Water system will not be accepted until negative bacteriological test is made on water taken from system. Repeat dosing as necessary until such negative test is accomplished.

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SECTION 22 11 19

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Balancing valves.
 - 2. Washer-supply outlets.
 - 3. Key-operation hydrants.
 - 4. Trap seal primer valves.
 - 5. Drain valves.
 - 6. Miscellaneous piping specialties.
 - 7. Sleeve penetration systems.
 - 8. Flashing materials.

1.2 QUALITY ASSURANCE

- A. Regulatory Agency Sustainability Approvals:
 - 1. Meet NSF International Standards for materials or products that come into contact with drinking water, drinking water treatment chemicals, or both for chemical contaminants and impurities that are indirectly imparted to drinking water from products, components, and materials used in drinking water systems.

PART 2 - PRODUCTS

2.1 BALANCING VALVES

- A. Calibrated Balancing Valves: Adjustable, with two readout ports and memory setting indicator. Include manufacturer's standard hoses, fittings, valves, differential pressure meter, and carrying case.
- B. Manufacturers:
 - 1. Armstrong Pumps, Inc.
 - 2. Flow Design, Inc.
 - 3. ITT Industries; Bell & Gossett Div.
 - 4. Taco, Inc.
 - 5. Watts Industries, Inc.; Water Products Div.
 - 6. 2" and Smaller: Bronze body with brass ball, adjustment knob, calibrated nameplate, and threaded or solder-joint ends.
 - 7. 2" and Smaller: Bronze, Y-pattern body with adjustment knob and threaded ends.
 - 8. 2.5" and Larger: Cast-iron, Y-pattern body with bronze disc and flanged or grooved ends.
- C. B. Memory-Stop Balancing Valves, NPS 2 (DN 50) and smaller: MSS SP-110, ball valve, rated for 400-psig (2760-kPa) mininmum CWP. Include two-piece, copper-alloy body with full-port, chrome-plated brass ball, replaceable seats and seals, threaded or solder-joint ends, and vinyl-covered steel handle with memory-stop device.

- D. Manufacturers:
 - 1. Conbraco Industries, Inc.
 - 2. Crane Co., Crane Valve Group; Crane Valves.
 - 3. Grinnell Corporation.
 - 4. NIBCO INC.
 - 5. Red-White Valve Corp.

2.2 STRAINERS

- A. Strainers: Y-pattern, unless otherwise indicated, and full size of connecting piping. Include ASTM A 666, Type 304, stainless-steel screens with 3/64-inch (1.2-mm) round perforations, unless otherwise indicated.
 - 1. Pressure Rating: 125-psig (860-kPa) minimum steam working pressure, unless otherwise indicated.
 - 2. NPS 2 (DN 50) and Smaller: Bronze body, with female threaded ends.
 - 3. NPS 2-1/2 (DN 65) and Larger: Cast-iron body, with interior AWWA C550 or FDA-approved, epoxy coating and flanged ends.

2.3 OUTLET BOXES

- A. Manufacturers:
 - 1. Acorn Engineering Company.
 - 2. Gray, Guy Manufacturing Co., Inc.
 - 3. Symmons Industries, Inc.
- B. General: Recessed-mounting outlet boxes with supply fittings complying with ASME A112.18.1M. Include box with faceplate, services indicated for equipment connections, and wood-blocking reinforcement.
- C. Clothes Washer Outlet Boxes: With hot- and cold-water hose connections, drain, and the following:
 - 1. Box and Faceplate: [Stainless steel] [Enameled or epoxy-painted steel].
 - 2. Shutoff Fitting: Two hose bibbs.
 - 3. Supply Fittings: Two NPS 1/2 (DN 15) gate, globe, or ball valves and NPS 1/2 (DN 15) copper, water tubing.
 - 4. Drain: NPS 2 (DN 50) standpipe, P-trap, and direct waste connection to drainage piping.
 - 5. Inlet Hoses: Two ASTM D 3571, 60-inch- (1500-mm-) long, rubber household clothes washer inlet hoses with female hose-thread couplings.
 - 6. Drain Hose: One 48-inch- (1200-mm-) long, rubber household clothes washer drain hose with hooked end.
- D. Icemaker Outlet Boxes: With hose connection and the following:
 - 1. Box and Faceplate: Stainless steel.
 - 2. Shutoff Fitting: Hose bibb.
 - 3. Supply Fitting: NPS 1/2 (DN 15) gate, globe, or ball valve and NPS 1/2 (DN 15) copper, water tubing.

2.4 KEY-OPERATION HYDRANTS

- A. Manufacturers:
 - 1. Josam Co.
 - 2. Smith, Jay R. Mfg. Co.
 - 3. Woodford Manufacturing Co.
- B. General: ASME A112.21.3M, key-operation hydrant with pressure rating of 125 psig.
 - 1. Inlet: 3/4 " or NPS 1" threaded or solder joint.
 - 2. Outlet: ASME B1.20.7, garden-hose threads.

- 3. Operating Keys: One with each key-operation hydrant.
- C. Moderate-Climate, Concealed-Outlet Wall Hydrants: ASSE 1019, self-drainable with flush-mounting box with cover, integral nonremovable hose-connection vacuum breaker, and concealed outlet.
 - 1. Classification: Type A, for automatic draining with hose removed or Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
- D. Hot and Cold, Nonfreeze Concealed-Outlet Wall Hydrants: With deep flush-mounting box with cover; hotand cold-water casings and operating rods to match wall thickness; concealed outlet; wall clamps; and factory- or field-installed, nonremovable and manual drain-type, hose-connection vacuum breaker complying with ASSE 1011.
- 2.5 ROOF HYDRANTS
 - A. Design Criteria:
 - 1. Provide dual check backflow preventer.
 - 2. Non-freeze.
 - 3. Drain port connect to drain
- 2.6 TRAP SEAL PRIMER VALVES
 - A. Supply-Type Trap Seal Primer Valves: ASSE 1018, water-supply-fed type, with the following characteristics:
 - B. Manufacturers:
 - 1. Josam Co.
 - 2. MIFAB Manufacturing, Inc.
 - 3. Precision Plumbing Products, Inc.
 - 4. Smith, Jay R. Mfg. Co.
 - 5. 125-psig (860-kPa) minimum working pressure.
 - 6. Bronze body with atmospheric-vented drain chamber.
 - 7. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
 - 8. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
 - 9. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.
- 2.7 MISCELLANEOUS PIPING SPECIALTIES
 - A. Water Hammer Arresters: ASSE 1010 or PDI-WH 201, metal-bellows type with pressurized metal cushioning chamber. Sizes indicated are based on ASSE 1010 or PDI-WH 201, Sizes A through F.
 - B. Manufacturers:
 - 1. Josam Co.
 - 2. Smith, Jay R. Mfg. Co.
 - 3. Tyler Pipe; Wade Div.
 - 4. Zurn Industries, Inc.; Specification Drainage Operation.
 - C. Hose Bibbs: Bronze body with replaceable seat disc complying with ASME A112.18.1M for compressiontype faucets. Include NPS 1/2 or NPS 3/4 (DN 15 or DN 20) threaded or solder-joint inlet, of design suitable for pressure of at least 125 psig (860 kPa); integral [or field-installed,] nonremovable, drainable hoseconnection vacuum breaker; and garden-hose threads complying with ASME B1.20.7 on outlet.
 - D. Roof Flashing Assemblies: Manufactured assembly made of [4-lb/sq. ft. (20-kg/sq. m), 0.0625-inch- (1.6-mm-)] [6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch- (2.4-mm-)] thick, lead flashing collar and skirt extending at least [6 inches (150 mm)] [8 inches (200 mm)] [10 inches (250 mm)] from pipe with galvanized steel boot reinforcement, and counterflashing fitting.

- E. Floor-Drain Inlet Fittings: Cast iron, with threaded inlet and threaded or spigot outlet, and trap seal primer valve connection.
- F. Fixed Air-Gap Fittings: Manufactured cast-iron or bronze drainage fitting with semiopen top with threads or device to secure drainage inlet piping in top and bottom spigot or threaded outlet larger than top inlet. Include design complying with ASME A112.1.2 that will provide fixed air gap between installed inlet and outlet piping.
- G. Stack Flashing Fittings: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
- H. Vent Caps: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and set-screws to secure to vent pipe.
- I. Vent Terminals: Commercially manufactured, shop- or field-fabricated, frost-proof assembly constructed of galvanized steel, copper, or lead-coated copper. Size to provide 1-inch (25-mm) enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.
- J. Expansion Joints: ASME A112.21.2M, assembly with cast-iron body with bronze sleeve, packing gland, and packing; of size and end types corresponding to connected piping.

2.8 SLEEVE PENETRATION SYSTEMS

- A. Manufacturers:
 - 1. ProSet Systems, Inc.
- B. Description: UL 1479, through-penetration firestop assembly consisting of sleeve and stack fitting with firestopping plug.
 - 1. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
 - 2. Stack Fitting: ASTM A 48 (ASTM A 48M), gray-iron, hubless-pattern, wye-branch stack fitting with neoprene O-ring at base and gray-iron plug in thermal-release harness in branch. Include PVC protective cap for plug.
 - 3. Special Coating: Include corrosion-resistant interior coating on fittings for plastic chemical waste and vent stacks.

2.9 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 - 1. General Use: 4-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness.
 - 2. Vent Pipe Flashing: 3-lb/sq. ft. (15-kg/sq. m), 0.0469-inch (1.2-mm) thickness.
 - 3. Burning: 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness.
- B. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.
- C. Fasteners: Metal compatible with material and substrate being fastened.
- D. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- E. Solder: ASTM B 32, lead-free alloy.
- F. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.
 - 1. Not required to meet NSF International Standards for Lead Free.
 - 2. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - 1) Jay R. Smith: 5907.
 - 2) Prier: P-RH2.

- 3) Woodford: RHY2-MS.
- 3. Water Hammer Arrestors:
 - 1. Design Criteria:
 - 1) Meet NSF International Standards for Lead Free.
 - 2) Nesting type, air pre-charged bellows with casing.
 - 3) Bellows constructed of stabilized 18-8 stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install pressure regulators with inlet and outlet shutoff valves and balance valve bypass. Install pressure gages on inlet and outlet.
- B. Install strainers on supply side of each control valve, pressure regulator, and solenoid valve.
- C. Install trap seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- D. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- E. Install expansion joints on vertical risers, stacks, and conductors if indicated.

3.2 CONNECTIONS

- A. Install piping adjacent to equipment to allow service and maintenance.
- B. Ground equipment.
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- D. Connect plumbing specialties and devices that require power.
- 3.3 FLASHING INSTALLATION
 - A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of lead sheets 4-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness or thinner.
 - B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.
 - C. Set flashing on floors and roofs in solid coating of bituminous cement.
 - D. Secure flashing into sleeve and specialty clamping ring or device.
 - E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to "Sheet Metal Flashing and Trim."
 - F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled trap seal primer systems and their installation, including piping and electrical connections. Report results in writing.
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

SECTION 22 13 13

FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Furnish and install soil, waste, and vent piping systems within building and connect with outside utility lines 5 feet out from building where applicable.
 - 2. Perform excavation and backfill required by work of this Section.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Cover Observation.
 - 1. Contact Architect/Engineer prior to covering any section of pipe.
 - 2. All piping all be under pressure during observation
- 1.3 REFERENCES
 - A. Reference Standards:
 - 1. International Code Council:
 - a. ICC IPC-2012, 'International Plumbing Code'.
- 1.4 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water (30 kPa).

1.5 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Shop Drawings: For solvent drainage system, include plans, elevations, sections, and details.
- C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- 1.6 QUALITY ASSURANCE
 - A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

- 2.1 PVC PIPING
 - A. PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent.
 - 1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.
 - B. PVC Special Fittings: ASTM F 409, drainage-pattern tube and tubular fittings with ends as required for application.
 - C. Plenum Vent Lines: In areas of building with a return air plenum.
 - 1. Approved Types:
 - a. Service weight, single-hub or no-hub type cast iron soil pipe meeting requirements of ASTM A74.
 - b. Vent lines 2-1/2 inches or smaller may be Schedule 40 galvanized steel.

- c. Joint Material:
 - 1) Single-Hub: Rubber gaskets meeting requirements of ASTM C564.
 - 2) No-Hub Pipe: Neoprene gaskets with stainless steel cinch bands.
- d. Fittings:
- e. Cast Iron Pipe: Hub and spigot, except fittings for no-hub pipe shall be no-hub, and meet requirements of ASTM A74.
 - 1) Joint Material: Rubber gaskets meeting requirements of ASTM C564.
 - 2) Galvanized Pipe: Screwed Durham tarred drainage type.
- 2.2 EXECUTION
- 2.3 PIPING INSTALLATION
 - A. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
 - B. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight.
 - C. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep ¼ bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8- bend fittings if 2 fixture are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
 - D. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
 - E. Re-verify building drainage piping slope before covering pipe in trench if left uncovered over a 24 hour period of subjected to exterior water. If slope of piping has changed, provide new shoring material to maintain original slope after trench has been covered.
 - F. Install soil and waste drainage and vent piping at the code required minimum slopes, unless otherwise indicated:
 - G. Install engineered soil and waste drainage and vent piping systems in locations indicated and as follows:
 - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 - 2. Cast-Iron, Sovent, Single Stack: Comply with ASSE 1043 and sovent fitting manufacturer's written installation instructions.
 - 3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
 - H. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
 - I. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
 - J. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
 - K. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

2.4 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code. Refer to Section "Plumbing Fixtures."
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger
- 2.5 FIELD QUALITY CONTROL
 - A. Field Tests:
 - 1. Conduct tests for leaks and defective work. Notify Architect before testing.
 - 2. Thermoplastic Pipe System:
 - a. Before backfilling and compacting of trenches, Fill waste and vent system with water to roof level or 10 feet minimum, and show no leaks for two hours. Correct leaks and defective work.
 - b. After backfilling and compacting of trenches is complete but before placing floor slab, re-test as specified above. Uncover pipe and correct leaks and defective work. Re-backfill and compact and re-test.
 - B. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughingin and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - C. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
 - D. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
 - E. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.

- 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
- 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
- 6. Prepare reports for tests and required corrective action.

2.6 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

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SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

- 1.1 SUMMARY
 - A. Products Furnished But Not Installed Under this Section as described in Contract Documents.
 - 1. Cleanouts.
 - 2. Floor drains.
- 1.2 PERFORMANCE REQUIREMENTS
 - A. Provide components and installation capable of producing piping systems with following minimum workingpressure ratings, unless otherwise indicated:
 - 1. Sanitary Waste and Vent Piping: 10-foot head of water.
 - 2. Storm Drainage Piping: 10-foot head of water.
- 1.3 SUBMITTALS
 - A. Product Data: Include rated capacities and shipping, installed, and operating weights. Indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections for the following:
 - 1. Cleanouts, floor drains, and roof drains.
 - 2. Roof flashing assemblies.
 - 3. Grease interceptors(if applicable)

4. Sleeve penetration systems.

PART 2 - PRODUCTS

- 2.1 SLEEVE PENETRATION SYSTEMS
 - A. Manufacturers:
 - 1. ProSet Systems, Inc.
 - B. Description: UL 1479, through-penetration firestop assembly consisting of sleeve and stack fitting with firestopping plug.
 - 1. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
 - 2. Stack Fitting: ASTM A 48 (ASTM A 48M), gray-iron, hubless-pattern, wye-branch stack fitting with neoprene O-ring at base and gray-iron plug in thermal-release harness in branch. Include PVC protective cap for plug.
 - a. Special Coating: Include corrosion-resistant interior coating on fittings for plastic chemical waste and vent stacks.

2.2 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 - 1. General Use: 4-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness.
 - 2. Vent Pipe Flashing: 3-lb/sq. ft. (15-kg/sq. m), 0.0469-inch (1.2-mm) thickness.
 - 3. Burning: 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness.

- B. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.
- C. Fasteners: Metal compatible with material and substrate being fastened.
- D. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- E. Solder: ASTM B 32, lead-free alloy.
- F. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.3 CLEANOUTS

- A. Cleanouts: Comply with [ASME A112.36.2M] [ASME A112.3.1] <Insert other>.
 - 1. Application: [Floor cleanout] [Wall cleanout] [For installation in exposed piping].
 - 2. Products:
 - a. Josam Co.
 - b. Mifab
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe, Wade Div.
 - e. Zurn Industries, Inc., Specification Drainage Operation.
- 2.4 FLOOR DRAINS
 - A. Floor Drains.
 - 1. Products:
 - a. Josam Co.
 - b. Mifab
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe, Wade Div.
 - e. Zurn Industries, Inc.

PART 3 - EXECUTION

- 3.1 INSTALLATION
 - A. Install trap seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
 - B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
 - C. Install expansion joints on vertical risers, stacks, and conductors if indicated.
 - D. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
 - E. Install cleanout deck plates with top flush with finished floor, for floor cleanouts for piping below floors.
 - F. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.

- G. Install flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.
- H. Install vent flashing sleeves on stacks passing through roof. Secure over stack flashing according to manufacturer's written instructions.
- I. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch (25-mm) clearance between vent pipe and roof substrate.
- J. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
 - b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
 - c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.
 - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- K. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.
 - 1. Install roof-drain flashing collar or flange so no leakage occurs between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 - 2. Position roof drains for easy access and maintenance.
- L. Install interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
 - 1. Flush with In-Ground Installation: Set unit and extension, if required, with cover flush with finished grade.
 - 2. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.
- M. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.
- N. Fasten recessed-type plumbing specialties to reinforcement built into walls.
- O. Install wood-blocking reinforcement for wall-mounting and recessed-type plumbing specialties.
- P. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

- A. Install piping adjacent to equipment to allow service and maintenance.
- B. Ground equipment.
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- D. Connect plumbing specialties and devices that require power according to Division Sections.
- E. Interceptor Connections: Connect piping, flow-control fittings, and accessories.

- 1. Grease Interceptors: Connect inlet and outlet to unit, and flow-control fitting and vent to unit inlet piping.
- 3.3 FLASHING INSTALLATION
 - A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of lead sheets 4-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness or thinner.
 - B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.
 - C. Set flashing on floors and roofs in solid coating of bituminous cement.
 - D. Secure flashing into sleeve and specialty clamping ring or device.
 - E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings.
 - F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- 3.4 FIELD QUALITY CONTROL
 - A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled trap seal primer systems and their installation, including piping and electrical connections. Report results in writing.
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- 3.5 PROTECTION
 - A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
 - B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

SECTION 22 33 00

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ELECTRIC DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Furnish and install electric water heater as specified in Contract Documents.
- B. Related Requirements:
 - 1. Section 22 0501: 'Common Plumbing Requirements'.
 - 2. Section 22 1116: 'Domestic Water Piping'.

1.2 REFERENCES

- A. Reference Standard:
 - 1. NSF International Standard / American National Standards Institute:
 - a. NSF/ANSI 61-2012, 'Drinking Water System Components Health Effects'.
 - b. NSF/ANSI 372-2011, 'Drinking Water System Components Lead Content'.
- B. SUBMITTALS
- C. Closeout Submittals:
 - 1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
 - a. Operations and Maintenance Data:
 - 1) Maintenance and operational instructions.
 - b. Warranty Documentation:
 - 1) Final, executed copy of Warranty.
 - c. Record Documentation:
 - 1) Manufacturers documentation:
 - a) Manufacturer's literature or cut sheet.
- 1.3 QUALITY ASSURANCE
 - A. Regulatory Agency Sustainability Approvals:
 - Meet NSF International Standards for materials or products that come into contact with drinking water, drinking water treatment chemicals, or both for chemical contaminants and impurities that are indirectly imparted to drinking water from products, components, and materials used in drinking water systems.
 - 2. California only: California Assembly Bill 1953 (AB1953) Compliant for Lead Free.

1.4 WARRANTY

- A. Special Warranty:
 - 1. Three-year non-prorated warranty on water heaters of 20 gallon capacity and larger.

PART 2 - PRODUCTS

- 2.1 ASSEMBLIES
 - A. Manufacturers:
 - 1. Manufacturer Contact List:
 - a. A O Smith Water Products Co,
 - b. Bradford-White Corp, Ambler,.
 - c. Rheem / Ruud Water Heater Div
 - d. Ruud Manufacturing Co.,

- e. State Industries Inc,
- B. Materials:
 - 1. Design Criteria:
 - a. All (wetted) drinking water products, components, and materials used in drinking water systems must meet NSF International Standards for Lead Free.
 - b. All water heaters require 'Tempered Water Temperature Control' (mixing valves) as specified in Section 22 1116.
 - 2. 30 Gallon to 50 Gallon Regular Height:
 - a. Glass lined storage tank pressure tested and rated for 125 psi (862 kPa) working pressure.
 - b. Water heaters shall each have ASME rated temperature-pressure relief valve rated at MBH input of heater minimum set to relieve at 120 psi (827 kPa).
 - c. 9 Kw.
 - d. 3 inches (75 mm) minimum glass fiber or polyurethane foam insulation.
 - e. Complete with two stage thermostat, magnesium anode, electric sheath rod type heating element, and high limit control.
 - f. Heater shall be pre-wired and entire unit bear UL label.
 - g. Manufactures
 - 1) American:
 - 2) A O Smith:
 - 3) Bradford White:
 - 4) Rheem
 - 5) State Industries: SB6-40.
- 2.2 ACCESSORIES
 - A. Anchoring Components:
 - 1. One inch (25 mm) by 18 ga (1.2 mm) galvanized steel straps.
 - 2. No. 10 by 2-1/2 inch (64 mm) screws.
 - B. Thermal Expansion Absorbers:
 - 1. Bladder type for use with potable water systems.
 - C. Type One Acceptable Products.
 - a. Therm-X-Trol ST-12-C by Amtrol Inc, West Warwick, RI www.amtrol.com.
 - b. Equal as approved by Architect before bidding.

PART 3 - EXECUTION

- 3.1 INSTALLATION
 - A. Install temperature-pressure relief valve on hot water heater and pipe discharge to directly above funnel of floor drain.
- 3.2 ADJUSTING
 - A. Set discharge water temperature at 140 deg F (60 deg C). Final hot water temperature shall be 110 deg F (43 deg C) after missing valve. If no mixing valve set discharge temperature at 110 deg F (43 deg C).

SECTION 22 42 00

COMMERCIAL PLUMBING FIXTURES

PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- 1.2 SUMMARY
 - A. This Section includes plumbing fixtures and related components.
- 1.3 DEFINITIONS
 - A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
 - B. Fitting: Device that controls flow of water into or out of plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- 1.4 SUBMITTALS
 - A. Product Data: Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports and indicate materials and finishes, dimensions, construction details, and flow-control rates for each type of fixture indicated.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Regulatory Requirements: Comply with requirements in U.S. Architectural & Transportation Barriers Compliance Board's "Uniform Federal Accessibility Standards (UFAS), 1985-494-187" about plumbing fixtures for people with disabilities.
- C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- E. TAS: Texas Accessibility Standards.
- 1.6 COORDINATION
 - A. Coordinate roughing-in and final plumbing fixture locations, and verify that fixtures can be installed to comply with original design and referenced standards.

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS
 - For fixture descriptions in other Part 2 articles where the subparagraph titles "Products," and "Manufacturers" introduce a list of manufacturers and their products or manufacturers only, the following requirements apply for product selection:

- 1. Products: Subject to compliance with requirements, provide one of the products specified in other Part 2 articles.
- 2.2 LAVATORY FAUCETS
 - A. Lavatory Faucet: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes and outlet with spout and fixture receptor.
 - 1. Products:
 - a. American Standard.
 - b. Eljer.
 - c. Kohler.
- 2.3 SINK FAUCETS
 - A. Sink Faucet: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes and outlet with spout and fixture receptor.
 - 1. Manufacturers:
 - a. American Standard.
 - b. Eljer
 - c. Kohler
- 2.4 TOILET SEATS
 - A. Toilet Seat: Solid plastic.
 - 1. Manufacturers:
 - a. Bemis.
 - b. Beneke.
 - c. Centoco.
 - d. Church.
- 2.5 PROTECTIVE SHIELDING GUARDS
 - A. Protective Shielding Guard, Manufactured, plastic enclosure for covering for hot- and cold-water supplies and trap and drain piping and complying with ADA requirements.
 - 1. Manufacturers:
 - a. Engineered Brass Co.
 - b. Plumerex
 - c. Truebro.
- 2.6 FIXTURE SUPPORTS
 - A. Water-Closet Support: Water-closet combination carrier designed for accessible and standard mounting heights. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.
 - 1. Manufacturers:
 - a. Mifab
 - b. Josam.
 - c. Wade.
 - d. Zurn
 - B. Urinal Support: Not required
 - C. Lavatory Support: Not required

- D. Sink Support: Type II, sink carrier with hanger plate, bearing studs, and tie rod. Include steel uprights with feet.
 - 1. Manufacturers:
 - a. Josam.
 - b. J.R. Smith
 - c. Zurn.
- 2.7 WATER CLOSETS
 - A. Water Closets: Accessible, wall-hanging, back-outlet, vitreous-china fixture designed for flushometer valve operation.
 - 1. Products:
 - 2. American Standard, Inc.
 - 3. Kohler Co.
 - 4. TOTO USA, Inc.
 - B. Water Closets: Ligature Resistant Institutional Combination Lavatory/Toilet
 - 1. Products:
 - a. ACORN
 - b. All others shall be submitted for pre-approval prior to bid date.
- 2.8 LAVATORIES, SINKS
 - A. Lavatories,: Accessible, counter top, vitreous-china fixture.
 - 1. Products:
 - a. American Standard, Inc.
 - b. Kohler Co.
 - c. Toto
 - d. CRANE
- 2.9 SINKS
 - A. Sinks: Commercial, counter-mounting, stainless-steel fixture.
 - 1. Products:
 - a. Elkay Manufacturing Co.
 - b. Just Manufacturing Co.

2.10 SERVICE SINKS

- A. Service/Mop Sinks: Floor-mounting, enameled, sink with front apron, raised back, and coated, wire rim guard.
 - 1. Products:
 - a. Commercial Enameling Co.
 - b. Kohler Co.
 - c. Fiat

PART 3 - EXECUTION

- 3.1 EXAMINATION
 - A. Examine roughing-in for water soil and for waste piping systems and supports to verify actual locations and sizes of piping connections and that locations and types of supports match those indicated, before plumbing fixture installation. Use manufacturer's roughing-in data if roughing-in data are not indicated.
 - B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.2 FIXTURE INSTALLATION
 - A. Assemble fixtures, trim, fittings, and other components according to manufacturers' written instructions.
 - B. For wall-hanging fixtures, install off-floor supports affixed to building substrate.
 - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 - 2. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
 - C. Install back-outlet, wall-hanging fixtures onto waste fitting seals and attach to supports.
 - D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
 - E. Install wall-hanging fixtures with tubular waste piping attached to supports.
 - F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.
 - G. Install counter-mounting fixtures in and attached to casework.
 - H. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.
 - Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 - 1. Exception: Use ball, gate, or globe valve if stops are not specified with fixture. Refer to Division 15 Section "Valves" for general-duty valves.
 - J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
 - K. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
 - L. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
 - M. Install toilet seats on water closets.
 - N. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
 - O. Install water-supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.
 - P. Install faucet, flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
 - Q. Install traps on fixture outlets.
 - R. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for escutcheons.
 - S. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildewresistant, silicone sealant. Match sealant color to fixture color. Refer to Division 7 Section "Joint Sealants" for sealant and installation requirements.
- 3.3 CONNECTIONS
 - A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
 - B. Connect water supplies from water distribution piping to fixtures.
 - C. Connect drain piping from fixtures to drainage piping.
 - D. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures. Connect to plumbing piping.

- E. Supply and Waste Connections to Fixtures and Equipment Specified in Other Sections: Connect fixtures and equipment with water supplies, stops, risers, traps, and waste piping specified. Use size fittings required to match fixtures and equipment. Connect to plumbing piping.
- F. Ground equipment.
 - Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- 3.4 FIELD QUALITY CONTROL
 - A. Verify that installed fixtures are categories and types specified for locations where installed.
 - B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.
 - C. Inspect installed fixtures for damage. Replace damaged fixtures and components.
 - D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets, shower valves, and flushometer valves to produce proper flow and stream.
- C. Replace washers and seals of leaking and dripping faucets and stops.

3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.

3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

SECTION 22 47 13

DRINKING FOUNTAINS

PART 1 - GENERAL

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Drinking fountains.
 - 2. Self-contained water coolers.
 - 3. Fixture supports.

1.3 DEFINITIONS

- A. Accessible Drinking Fountain and Water Cooler: Fixture that can be approached and used by people with disabilities.
- B. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.
- C. Fitting: Device that controls flow of water into or out of fixture.
- D. Fixture: Drinking fountain or water cooler, unless one is specifically indicated.
- E. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each type of fixture indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring and differentiate between manufacturerinstalled and field-installed wiring.
- C. Maintenance Data: For fixtures to include in maintenance manuals specified in Division.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" about fixtures for people with disabilities.
- C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- D. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.
- E. TAS: Texas Accessibility Standards.
- 1.6 COORDINATION
 - A. Coordinate roughing-in and final fixture locations, and verify that fixtures can be installed to comply with original design and referenced standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified below.
 - 1. Elkay.
 - 2. Halsey Taylor.
 - 3. Haws Corporation.
- 2.2 DRINKING FOUNTAINS
 - A. Drinking Fountains,: Accessible, Style W, wall-hanging fixture made of stainless steel.
 - 1. Receptor Shape: Rectangular.
 - 2. Back Panel: Stainless-steel wall plate behind drinking fountain.
 - 3. Bubblers: Two, with automatic stream regulator, located on deck.
 - 4. Control: Push button.
 - 5. Supply: NPS 3/8 (DN 10) with ball, gate, or globe valve.
 - 6. Drain: Grid with NPS 1-1/4 (DN 32) minimum horizontal waste and trap complying with ASME Standards.
 - 7. Support: Type I, water-cooler carrier. Refer to "Fixture Supports" Article.

2.3 SELF-CONTAINED WATER COOLERS

- A. Water Coolers: Accessible, ARI 1010, Type PB, pressure with bubbler, Style W, wall-hanging fixture.
 - 1. Cabinet: Bilevel with two attached cabinets, enameled steel with stainless-steel top.
 - 2. Bubbler: One, with automatic stream regulator, located on each cabinet deck.
 - 3. Control: Push button.
 - 4. Supply: NPS 3/8 (DN 10) with ball, gate, or globe valve and filter.
 - 5. Drain: Grid with NPS 1-1/4 (DN 32) minimum horizontal waste and trap complying with ASME Standards.
 - 6. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
 - a. Capacity: 8 gph (0.0084 L/s) of 50 deg F (10 deg C) cooled water from 80 deg F (27 deg C) inlet water and 90 deg F (32 deg C) ambient air temperature.
 - b. Electrical Characteristics: 1/5 hp; 120-V ac; single phase; 60 Hz.
 - 7. Support: Type II, water-cooler carrier. Refer to "Fixture Supports" Article.
- 2.4 FIXTURE SUPPORTS
 - A. Off-Floor, Plumbing Fixture Supports: ASME A112.6.1M, water-cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.
 - 1. Available Manufacturers:
 - 2. Manufacturers:
 - a. Josam Co.
 - b. Smith, Jay R. Mfg. Co.
 - c. Tyler Pipe; Wade Div.
 - d. Zurn Specifications Drainage Operation.
 - 3. Type I: Hanger-type carrier with two vertical uprights.
 - 4. Type II: Bilevel, hanger-type carrier with three vertical uprights.
 - 5. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 - EXECUTION

- 3.1 EXAMINATION
 - A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.
 - B. Examine walls and floors for suitable conditions where fixtures are to be installed.
 - C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Use carrier off-floor supports for wall-hanging fixtures, unless otherwise indicated.
- B. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.
- 3.3 INSTALLATION
 - A. Install off-floor supports affixed to building substrate and attach wall-hanging fixtures, unless otherwise indicated.
 - B. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.
 - C. Install fixtures level and plumb.
 - D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Refer to Division Section "Valves" for general-duty valves.
 - E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
 - F. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Refer to Division Section "Basic Mechanical Materials and Methods" for escutcheons.
 - G. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Refer to Division for sealant and installation requirements.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect water supplies from water distribution piping to fixtures.
- C. Connect drain piping from fixtures to drainage piping.
- D. Ground equipment.
 - Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

SECTION 23 00 00

HEATING, VENTILATION AND AIR-CONDITIONING (HVAC)

PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions
- 1.2 WORK COVERED BY CONTRACT DOCUMENTS
 - A. The following Summary of Work is intended as an aid to achieve an understanding of the various elements of work included in the project, as is not intended to be all-inclusive. Detailed descriptions of work and requirements are given in drawings and specifications.
 - B. Mechanical Contract Documents were prepared for the Project by:

Trinity MEP Engineering, LLC 3533 Moreland Dr. Ste. A Weslaco, Texas 78596 Phone Number: (956) 973-0500 Contact Person: Leonardo Munoz, P.E.

- C. General Scope of Work:
 - 1. Install AC equipment and ductwork as shown on the contract documents. Refer to drawings for schedule of equipment that will be installed. After installing equipment, connect power to unit.
 - 2. <u>HVAC</u>: Provide all materials and labor associated with a complete operational installation of new HVAC systems including, but not limited to:
 - DX Split System A/C Units
 - Exhaust fans
 - Sheet metal, Ductwork
 - Diffusers and Grilles
 - Duct accessories, including grilles, and louvers
 - Air Test and Balance

1.3 COORDINATION

- A. All mechanical work shall be done under sub-contract to a General Contractor. Mechanical Contractor shall coordinate all work through General Contractor, even in areas where only mechanical work is to take place.
- B. Coordination between all trades shall take place on a regular basis to avoid conflicts between disciplines and equipment clearances.
- C. Work shall take place with minimal disruption to Owner's operations in areas surrounding the new building.
- D. Cooperate fully with other contractors so that work under those contracts may be carried out smoothly, without interfering with or delaying work under this Contract.

- E. Fully coordinate with electrical contractor for providing power to mechanical equipment.
- F. Mechanical Contractor is responsible for all control wiring including thermostat(s). This includes all conduit, wire, and accessories both low voltage and source voltage for the controls' system. Mechanical Contractor will provide all the necessary actuators, relays, software, hardware, and all necessary accessories required for a fully functional controls' system.
- 1.4 UTILITIES
 - 1. Coordinate with power, water, telephone, cable and gas utilities to locate all utilities prior to digging in any area.
 - 2. Obtain any approvals required from utilities to relocate utilities.
 - 3. Cost of relocating or bypassing utilities indicated on drawings shall be included in Base Bid.
- 1.5 CONTRACTOR USE OF PREMISES
 - A. Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.
 - 1. Owner Occupancy: Allow for Owner occupancy and use by the public.
 - 2. Driveways and Entrances: Keep driveways and entrances serving the premises, clear and available to the Owner, the Owner's employees, and emergency vehicles at all time. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
 - B. Site Safety: Take every precaution to ensure the site does not present a threat to the safety of occupants and/or workers. Minimal safety requirements include, but are not limited to the following:
 - 1. Temporary fencing around construction areas.
 - 2. Yellow caution tape and construction barricades along open trenches during the day. Trenches shall be covered at night and warning lights provided on construction barricades.
 - 3. Temporary fencing around equipment while site work is in progress.
 - 1.6 SUBMITTALS
 - 1. To extradite the submittal process more efficiently, DO NOT piece-meal the submittals. Submit entire mechanical or plumbing in a bound enclosure. This will eliminate delays in the submittal process.
SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS
- 1.2 SUMMARY
 - A. This Section includes the following basic mechanical materials and methods to complement other Sections.
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Concrete base construction requirements.
 - 3. Escutcheons.
 - 4. Dielectric fittings.
 - 5. Flexible connectors.
 - 6. Mechanical sleeve seals.
 - 7. Equipment nameplate data requirements.
 - 8. Nonshrink grout for equipment installations.
 - 9. Field-fabricated metal and wood equipment supports.
 - 10. Installation requirements common to equipment specification sections.
 - 11. Cutting and patching.
 - 12. Touchup painting and finishing.
- 1.3 DEFINITIONS
 - A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
 - B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
 - C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
 - D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
 - E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
 - F. The following are industry abbreviations for plastic materials:
 - G. PVC: Polyvinyl chloride plastic.
 - H. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene propylene diene terpolymer rubber.
- 1.4 SUBMITTALS

- A. Product Data: For dielectric fittings, flexible connectors, mechanical sleeve seals, and identification materials and devices.
- B. Coordination Drawings: Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:
 - 1. Planned piping layout, including valve and specialty locations and valve-stem movement.
 - 2. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
 - 3. Sizes and location of required concrete pads and bases.
 - 4. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
 - 5. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, and other ceiling-mounted items.

1.5 QUALITY ASSURANCE

- A. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
- B. Equipment Selection: Equipment of higher electrical characteristics, physical dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. Additional costs shall be approved in advance by appropriate Contract Modification for these increases. If minimum energy ratings or efficiencies of equipment are specified, equipment must meet design and commissioning requirements.
- 1.6 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.
 - B. Protect stored pipes, ductwork, equipment, and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.
 - C. Protect flanges, fittings, and piping specialties from moisture and dirt.
 - D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 SEQUENCING AND SCHEDULING

- A. Coordinate mechanical equipment installation with other building components.
- B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
- C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.
- D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
- E. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- F. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in architectural section.

- G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.
- 1.8 OPERATION PRIOR TO ACCEPTANCE
 - A. When any equipment is operable, and it is to the advantage of the Contractor to operate the equipment, he may do so provided that he properly supervises the operation, and retains full responsibility for the equipment operated.
 - B. Regardless of whether or not the equipment has or has not been operated, the Contractor shall clean the equipment properly, make required adjustments, and complete punch list items before final acceptance by the Owner.
 - C. The date of acceptance by the Engineer, for beneficial use by the Owner, shall be the beginning date of the warranty period.
- 1.9 SPACE AND EQUIPMENT ARRANGEMENT
 - A. The size of each item of mechanical equipment shown on the Drawings is based on the dimensions of a particular manufacturer as indicated. While other manufacturers may be acceptable, it shall be the responsibility of the Contractor to determine whether or not the equipment he proposes to furnish will fit into the space. Shop drawings shall be prepared when required by the engineer to indicate a suitable arrangement.
 - B. Install equipment in a manner to permit access to all surfaces. Install valves, motors, drives, lubricating devices, filters, and other accessory items in a position to allow removal for service without requiring the disassembly of another part.
 - C. Provide access panels acceptable to the Engineer for equipment that is concealed above ceiling space.
 - D. Large equipment assemblies or components which will be installed in the building, and which are too large to permit access through doorways, stairways or shafts, shall be brought to the site and placed in the appropriate spaces before the enclosing structure is completed. Provisions shall be implemented by the Contractor to insure that the equipment will not be damaged in any way during the associated construction procedures.
- 1.10 START-UP OF EQUIPMENT AND SYSTEMS
 - A. Whenever the manufacturer of a particular item of equipment or a particular system makes available a start-up service after completion of the installation, such manufacturer's start-up service (rendered by the manufacturer or his authorized representative) shall be provided.
 - B. Witnessing and explanations of start-up services shall be included as part of the "Instruction of Owner's Personnel" as specified below.
- 1.11 INSTRUCTION OF OWNER'S PERSONNEL
 - A. Provide the services of competent engineers or technicians acceptable to the Engineer to instruct representatives of the Owner in complete and detailed operation and maintenance of each item of equipment, and each system. These instructions shall be provided for whatever periods may be necessary to accomplish the desired results. Upon completion of these instructions, the Contractor shall obtain a letter of release, acknowledged by the Owner or his authorized representative, stating the dates on which the various kinds of instruction were given, and the personnel to whom the instructions were given.
 - B. The Contractor shall be fully responsible for proper maintenance of equipment and systems until the instructions have been given to the Owner's personnel and the letter of release acknowledged.

- C. In providing the instructions to the Owner's personnel, the written operating and maintenance manuals shall be followed in all instances, and the Owner's personnel shall be familiarized with such manuals. Operating and maintenance manuals used for instructions shall include piping diagrams, valve identification charts, control and interlocking wiring diagrams, manufacturers' operation and maintenance manuals, parts lists (with sources identified), and other data as appropriate for each system, and as required elsewhere in the Specifications to be furnished to the Owner prior to final acceptance of the project.
- D. Provide the Owner with three (3) complete sets of all maintenance manuals, pamphlets, brochures or instructions. This material shall be catalogued, indexed and bound into books.

1.12 ACCEPTABLE MANUFACTURERS

A. A. Provide equipment and materials from listed manufacturers listed within this specification. Deviations from this specification will not be acceptable. When one manufacturer is listed, alternate materials and equipment may be provided "equal to" the listed. When more than one manufacturer is listed, equipment and material must be provided by one of the listed manufacturers.

PART 2 - PRODUCTS

2.1 STANDARD PRODUCTS

- A. Each item of equipment furnished under this Division of the Specifications shall be essentially the standard product of the manufacturer. Where two or more units of the same kind or class of equipment are required, these shall be the products of a single manufacturer; however, the component parts of the equipment need not be the products of one manufacturer.
- B. Materials and equipment shall be of the base quality normally used in good commercial practice, and shall be the products of reputable domestic manufacturers unless otherwise specified. Each major component shall bear a nameplate giving the name and address of the manufacturer, and the catalog number or designation of the component.

2.2 QUALITY AND CLASSIFICATION OF MATERIALS

- A. Materials and equipment shall be new and of the quality specified, and shall be free from defects at the time of installation. Materials or equipment damaged in shipment or otherwise damaged prior to installation shall not be repaired at the job site, but shall be replaced with new materials or equipment identical with those damaged.
- B. Wherever a UL standard has been established for a particular type of material or equipment, each such material or equipment provided on this project shall meet the requirements of the UL standard in every way and shall be UL listed and labeled.

2.3 LOCAL PARTS AND SERVICE

- A. Each item of equipment furnished on this project shall have local representation, factory-authorized service, and an adequate stock of repair parts. "Local" shall be defined, for this purpose, as "within 50 miles of the project site."
- 2.4 FLAME SPREAD PROPERTIES OF MATERIALS
 - A. Materials used for insulation, acoustical linings, adhesives, jackets and coatings, and combinations of these materials, shall each have a flame spread rating of 25 or less, and a smoke developed rating of 50 or less, as determined by an independent testing laboratory in accordance with NFPA-255.

2.5 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:1. Dielectric Unions:

- a. Watts Industries, Inc.; Water Products Div.
- b. Zurn Industries, Inc.; Wilkins Div.
- 2. Mechanical Sleeve Seals:
 - a. Calpico, Inc.
 - b. Metraflex Co.
 - c. Thunderline/Link-Seal.
- 2.6 MECHANICAL SLEEVE SEALS
 - A. Description: Modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates.
- 2.7 PIPING SPECIALTIES
 - A. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
 - 1. Steel Sheet Metal: 0.0239-inch minimum thickness, galvanized, round tube closed with welded longitudinal joint.
 - 2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
 - 3. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
 - 4. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - a. Underdeck Clamp: Clamping ring with set screws.
 - B. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type if required to conceal protruding fittings and sleeves.
 - 1. ID: Closely fit around pipe, tube, and insulation of insulated piping.
 - 2. OD: Completely cover opening.
 - 3. Cast Brass: One piece, with set screw.
 - a. Finish: Rough brass.
 - b. Finish: Polished chrome-plate.
 - 4. Cast-Iron Floor Plate: One-piece casting.
- 2.8 GROUT
 - A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.
 - 1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psig, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

- 3.1 PIPING SYSTEMS COMMON REQUIREMENTS
 - A. General: Install piping as described below, unless piping Sections specify otherwise. Individual Sections specify unique piping installation requirements.
 - B. General Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, unless deviations to layout are approved on Coordination Drawings.
 - C. Install piping at indicated slope.
 - D. Install components with pressure rating equal to or greater than system operating pressure.

- E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.
- F. Install piping free of sags and bends.
- G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.
- H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
- I. Install piping to allow application of insulation plus 1-inch clearance around insulation.
- J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- K. Install fittings for changes in direction and branch connections.
- L. Install couplings according to manufacturer's written instructions.
- M. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:
 - 1. Chrome-Plated Piping: Cast brass, one piece, with set screw, and polished chrome-plated finish.
 - 2. Uninsulated Piping Wall Escutcheons: Cast brass or stamped steel, with set screw.
 - 3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
 - 4. Insulated Piping: Cast brass or stamped steel; with concealed hinge, spring clips, and chrome-plated finish.
 - 5. Piping in Utility Areas: Cast brass or stamped steel, with set-screw or spring clips.
- N. Sleeves are not required for core drilled holes.
- O. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Build sleeves into new walls and slabs as work progresses.
 - 3. Install sleeves large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:Steel Pipe Sleeves: For pipes smaller than 6-inch NPS.
 b. Steel, Sheet-Metal Sleeves: For pipes 6-inch NPS and larger, penetrating gypsum-board partitions.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants.
 - 5. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated.
- Q. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe or pipe insulation and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches in diameter and larger.
 - 3. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
- R. Underground, Exterior-Wall, Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

- Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping materials.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- V. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:
 - 1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 - 2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 - 3. Soldered Joints: Construct joints according to AWS's "Soldering Manual," Chapter "The Soldering of Pipe and Tube"; or CDA's "Copper Tube Handbook."
 - 4. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 5. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 - b. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
 - c. Align threads at point of assembly.
 - d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
 - e. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
 - 6. Welded Joints: Construct joints according to AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators according to "Quality Assurance" Article.
 - 7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
 - 8. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following:
 - a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - b. PVC Nonpressure Piping: ASTM D 2855.
 - c. PVC to ABS Nonpressure Transition Fittings: Procedure and solvent cement according to ASTM D 3138.
 - 9. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657 procedures and manufacturer's written instructions.
 - a. Plain-End Pipe and Fittings: Use butt fusion.
 - b. Plain-End Pipe and Socket Fittings: Use socket fusion.
- W. Piping Connections: Make connections according to the following, unless otherwise indicated:

- 1. Install unions, in piping 2-inch NPS and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS or smaller threaded pipe connection.
- 2. Install flanges, in piping 2-1/2-inch NPS and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
- 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
- 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.
- 3.2 EQUIPMENT AND MATERIAL INSTALLATION COMMON REQUIREMENTS
 - A. Install equipment and material to provide maximum possible headroom, if mounting heights are not indicated.
 - B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Architect.
 - C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
 - D. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
 - E. Install equipment and ductwork giving right of way to piping installed at required slope.
 - F. Install flexible connectors on equipment side of shutoff valves, horizontally and parallel to equipment shafts if possible.
- 3.3 PAINTING AND FINISHING
 - A. Refer to paint materials, surface preparation, and application of paint.
 - B. Do not paint piping specialties with factory-applied finish.
 - C. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- 3.4 CONCRETE BASES
 - A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psig, 28-day compressive-strength concrete and reinforcement or as specified.
- 3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGE
 - A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
 - B. Field Welding: Comply with AWS D1.1, "Structural Welding Code--Steel."
- 3.6 CUTTING AND PATCHING
 - A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved.
 - B. Repair cut surfaces to match adjacent surfaces.
- 3.7 GROUTING
 - A. Install nonmetallic, nonshrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.
 - B. Clean surfaces that will come into contact with grout.
 - C. Provide forms as required for placement of grout.
 - D. Avoid air entrapment during placing of grout.

- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases to provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout according to manufacturer's written instructions.

SECTION 23 05 29

HANGER & SUPPORTS FOR HVAC PIPING & EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

.1 Section includes:

.1 Concrete housekeeping pads, hangers and supports for mechanical piping, ducting and equipment.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 Submittal Procedures.
- .2 Section 01 74 21 Construction/Demolition Waste Management and Disposal
- .3 Section 03 30 00 Cast-in-Place Concrete.
- .4 Section 05 12 23 Structural Steel for Buildings.
- .5 Section 05 50 00 Metal Fabrications.

1.3 REFERENCES

- .1 American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME)
 - .1 ANSI/ASME B31.1, Power Piping, (SI Edition).
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM A125, Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A563, Specification for Carbon and Alloy Steel Nuts.
- .3 Factory Mutual (FM)
- .4 Health Canada / Workplace Hazardous Materials Information System (WHMIS).
 - .1 Materials Safety Data Sheets (MSDS).
- .5 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP-58, Pipe Hangers and Supports Materials, Design and Manufacture.
 - .2 ANSI/MSS SP-69, Pipe Hangers and Supports Selection and Application.
 - .3 MSS SP-89, Pipe Hangers and Supports Fabrication and Installation Practices.
- .6 Underwriter's Laboratories of Canada (ULC)

1.4 SYSTEM DESCRIPTION

- .1 Design Requirements
 - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
 - .2 Base maximum load ratings on allowable stresses prescribed by MSS SP58 or ASME B31.1.
 - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
 - .4 Design hangers and supports to support systems under all conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
 - .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment to be in accordance with MSS SP58.

- .2 Performance Requirements
 - .1 Design supports, platforms, catwalks, hangers, to withstand seismic events for location as per the National Building Code

1.5 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 Submittal Procedures.
- .2 Shop drawings: submit drawings stamped and signed for approval by Owner's Representative.
- .3 Submit shop drawings and product data for following items:
 - .1 Bases, hangers and supports.
 - .2 Connections to equipment and structure.
 - .3 Structural assemblies.
- .4 Quality assurance submittals: submit following in accordance with Section 01 33 00 Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
 - .1 Owner's Representative will make available 1 copy of systems supplier's installation instructions.
- .5 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 -Closeout Submittals

1.6 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 -Health and Safety Requirements.
- 1.7 DELIVERY, STORAGE, AND HANDLING
 - .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

- 2.1 GENERAL
 - .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP-58 and SP-89.
 - .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.2 PIPE HANGERS

- .1 Finishes:
 - .1 Pipe hangers and supports: galvanized painted with zinc-rich paint after manufacture.
 - .2 Use electro-plating galvanizing process or hot dipped galvanizing process.
 - .3 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.
- .2 Upper attachment structural: Suspension from lower flange of I-Beam.

- .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
 - .1 Rod: 9 mm UL listed, 13 mm FM approved.
- .2 Cold piping NPS 2 1/2 or greater, hot piping: Malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed, FM approved where required to MSS-SP58 and MSS-SP69.
- .3 Upper attachment structural: Suspension from upper flange of I-Beam.
 - .1 Cold piping NPS 2 maximum: Ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed FM approved where required to MSS SP69.
 - .2 Cold piping NPS 2 1/2 or greater, all hot piping: Malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed, FM approved where required.
- .4 Upper attachment to concrete.
 - .1 Ceiling: Carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
 - .2 Concrete inserts: wedge shaped body with knockout protector plate UL listed FM approved where required to MSS SP-69.
- .5 Shop and field-fabricated assemblies.
 - .1 Trapeze hanger assemblies: MSS SP-89.
 - .2 Steel brackets: MSS SP-89.
 - .3 Sway braces for seismic restraint systems: to MSS SP-89.
- .6 Hanger rods: threaded rod material to MSS SP-58.
 - .1 Ensure that hanger rods are subject to tensile loading only.
 - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
 - .3 Do not use 22 mm or 28 mm rod.
- .7 Pipe attachments: material to MSS SP-58.
 - .1 Attachments for steel piping: carbon steel galvanized.
 - .2 Attachments for copper piping: copper plated black steel.
 - .3 Use insulation saddles for hot pipework.
 - .4 Oversize pipe hangers and supports for insulated pipes.
- .8 Adjustable clevis: material to MSS SP-69, UL listed FM approved, where required clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
 - .1 Ensure "U" has hole in bottom for rivetting to insulation shields.
- .9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP-69.
- .10 U-bolts: carbon steel to MSS SP-69 with 2 nuts at each end to ASTM A563.
 - .1 Finishes for steel pipework: galvanized.
 - .2 Finishes for copper, glass, brass or aluminum pipework: black with formed portion plastic coated or epoxy coated.
- .11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP-69.
- 2.3 RISER CLAMPS
 - .1 Steel or cast iron pipe: galvanized black carbon steel to MSS SP-58, type 42, UL listed FM approved where required.
 - .2 Copper pipe: carbon steel copper plated to MSS SP-58, type 42.
 - .3 Bolts: to ASTM A307.
 - .4 Nuts: to ASTM A563.

2.4 INSULATION PROTECTION SHIELDS

- .1 Insulated cold piping:
 - .1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP-69, galvanized sheet carbon steel. Length designed for maximum 3 m span.
- .2 Insulated hot piping:
 - .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP-69.

2.5 CONSTANT SUPPORT SPRING HANGERS

- .1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report(CMTR).
- .2 Load adjustability: 10 % minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.
- .3 Provide upper and lower factory set travel stops.
- .4 Provide load adjustment scale for field adjustments.
- .5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.
- .6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.6 VARIABLE SUPPORT SPRING HANGERS

- .1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.
- .2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.
- .3 Variable spring hanger to be complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.
- .4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.7 EQUIPMENT SUPPORTS

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings. Submit calculations with shop drawings.

2.8 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

.1 Provide templates to ensure accurate location of anchor bolts.

2.9 PLATFORMS AND CATWALKS

.1 To Section 05 50 00 - Metal Fabrication.

2.10 HOUSE-KEEPING PADS

- .1 For base-mounted equipment: Concrete, at least 100 mm high, 50 mm larger all around than equipment, and with chamfered edges.
- .2 Concrete: to Section 03 30 00 Cast-in-place Concrete by Division 3.

2.11 OTHER EQUIPMENT SUPPORTS

- .1 From structural grade steel meeting requirements of Section 05 12 23 Structural Steel for Buildings.
- .2 Submit structural calculations with shop drawings.

PART 3 - EXECUTION

- 3.1 MANUFACTURER'S INSTRUCTIONS
 - .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- 3.2 INSTALLATION
 - .1 Install in accordance with:
 - .1 Manufacturer's instructions and recommendations.
 - .2 Vibration Control Devices:
 - .1 Install on piping systems at pumps, boilers, chillers, cooling towers, elsewhere as indicated.
 - .3 Clamps on riser piping:
 - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
 - .2 Bolt-tightening torques to be to industry standards.
 - .3 Steel pipes: Install below coupling or shear lugs welded to pipe.
 - .4 Cast iron pipes: Install below joint.
 - .4 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
 - .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
 - .6 Use approved constant support type hangers where:
 - .1 vertical movement of pipework is 13 mm or more,
 - .2 transfer of load to adjacent hangers or connected equipment is not permitted.
 - .7 Use variable support spring hangers where:
 - .1 transfer of load to adjacent piping or to connected equipment is not critical.
 - .2 variation in supporting effect does not exceed 25 % of total load.

3.3 HANGER SPACING

- .1 Plumbing piping: most stringent requirements of Canadian Plumbing Code
- .2 Fire protection: to applicable fire code.
- .3 Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.
- .4 Copper piping: up to NPS 1/2: every 1.5 m.
- .5 Hydronic, steam, condensate, rigid, and flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.

Maximum Pipe	Maximum Spacing: Steel	Maximum Spacing: Copper			
Size: NPS					
up to 1-1/4	2.1 m	1.8 m			
1-1/2	2.7 m	2.4 m			
2	3.0 m	2.7 m			
2-1/2	3.6 m	3.0 m			
3	3.6 m	3.0 m			
3-1/2	3.9 m	3.3 m			
4	4.2 m	3.6 m			
5	4.8 m				
6	5.1 m				
8	5.7 m				

Maximum Pipe Size: NPS	Maximum Spacing: Steel	Maximum Spacing: Copper
10	6.6 m	
12	6.9 m	

- .6 Within 300 mm of each elbow.
- .7 Pipework greater than NPS 12: to MSS SP69.

3.4 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members, comprised of angel iron or c-channel.
- 3.5 HORIZONTAL MOVEMENT
 - .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
 - .2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 FINAL ADJUSTMENT

- .1 Adjust hangers and supports:
 - .1 Ensure that rod is vertical under operating conditions.
 - .2 Equalize loads.
- .2 Adjustable clevis:
 - .1 Tighten hanger load nut securely to ensure proper hanger performance.
 - .2 Tighten upper nut after adjustment.
- .3 C-clamps:
 - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
 - .1 Hammer jaw firmly against underside of beam.

SECTION 23 05 63

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions.

1.2 SUMMARY

- A. This Section includes the following mechanical identification materials and their installation:
 - 1. Equipment nameplates.
 - 2. Equipment markers.
 - 3. Access panel and door markers.
 - 4. Pipe markers.
 - 5. Duct markers.
 - 6. Valve tags.
- 1.3 SUBMITTALS
 - A. Product Data: For each type of product indicated.
- 1.4 COORDINATION
 - A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
 - B. Coordinate installation of identifying devices with location of access panels and doors.
 - C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

- 2.1 EQUIPMENT IDENTIFICATION DEVICES
 - A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
 - 1. Data:
 - a. Manufacturer, product name, model number, and serial number.
 - b. Capacity, operating and power characteristics, and essential data.
 - c. Labels of tested compliances.
 - 2. Location: Accessible and visible.
 - 3. Fasteners: As required to mount on equipment.
 - B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
 - 1. Terminology: Match schedules as closely as possible.
 - 2. Data:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
 - Size: 2-1/2 by 4 inches (64 by 100 mm) for control devices, dampers, and valves; 4-1/2 by 6 inches (115 by 150 mm) for equipment.
 - 4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.2 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
 - 1. Colors: Comply with ASME A13.1, unless otherwise indicated.
 - 2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
 - 3. Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Full-band pipe markers extending 360 degrees around pipe at each location.
 - 4. Pipes with OD, Including Insulation, 6 Inches (150 mm) and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
 - 5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.
- C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.
- D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.
- E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils (0.08 mm) thick with pressure-sensitive, permanent-type, self-adhesive back.
 - Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): 3/4 inch (19 mm) minimum.
 - Width for Markers on Pipes with OD, Including Insulation, <u>6 Inches</u> (150 mm) or Larger: <u>1-1/2 inches</u> (38 mm) minimum.
- 2.3 DUCT IDENTIFICATION DEVICES
 - A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.
- 2.4 VALVE TAGS
 - A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers, with numbering scheme [approved by Architect] <Insert other>. Provide 5/32-inch (4-mm) hole for fastener.
 - 1. Material: 3/32-inch- (2.4-mm-) thick laminated plastic with 2 black surfaces and white inner layer.
 - 2. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook.

PART 3 - EXECUTION

- 3.1 APPLICATIONS, GENERAL
 - A. Products specified are for applications referenced in other Divisions. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.
- 3.2 EQUIPMENT IDENTIFICATION
 - A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
 - 1. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - 2. Heat exchangers, coils, evaporators, and similar equipment.

- 3. Fans, blowers, primary balancing dampers, and mixing boxes.
- 4. Packaged HVAC central-station and zone-type units.
- B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
 - Letter Size: Minimum 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 - 3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Fire department hose valves and hose stations.
 - c. Meters, gages, thermometers, and similar units.
 - d. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - e. Heat exchangers, coils, evaporators, and similar equipment.
 - f. Fans, blowers, primary balancing dampers, and mixing boxes.
 - g. Packaged HVAC central-station and zone-type units.
 - h. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
- C. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.
 - 1. Identify mechanical equipment with equipment markers in the following color codes:
 - a. Green: For cooling equipment and components.
 - b. Yellow: For heating equipment and components.
 - c. Orange: For combination cooling and heating equipment and components.
 - Letter Size: Minimum 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 - 4. Include signs for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices.
 - b. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - c. Heat exchangers, coils, evaporators, and similar equipment.
 - d. Fans, blowers, primary balancing dampers, and mixing boxes.
 - e. Packaged HVAC central-station and zone-type units.
 - f. Tanks and pressure vessels.
 - g. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
- D. Install access panel markers with screws on equipment access panels.

3.3 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
 - 1. Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Pretensioned pipe markers. Use size to ensure a tight fit.
 - Pipes with OD, Including Insulation, 6 Inches (150 mm) and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches (38 mm) wide, lapped at least 3 inches (75 mm) at both ends of pipe marker, and covering full circumference of pipe.
- B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and nonaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

3.4 DUCT IDENTIFICATION

- A. Install duct markers with permanent adhesive on air ducts in the following color codes:
 - 1. Green: For cold-air supply ducts.
 - 2. Blue: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 - 3. ASME A13.1 Colors and Designs: For hazardous material exhaust.
 - 4. Letter Size: Minimum 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- B. Locate markers near points where ducts enter into concealed spaces and at maximum intervals of 50 feet (15 m) in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factoryfabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of enduse fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:
 - 1. Valve-Tag Size and Shape:
 - a. Cold Water: 1-1/2 inches (38 mm), round.
 - b. Hot Water: 1-1/2 inches (38 mm), round.
 - c. Fire Protection: 2 inches (50 mm), round.
- C. Valve-Tag Color:

- a. Cold Water: Green.
- b. Hot Water: Yellow.
- c. Fire Protection: Red.
- 2. Letter Color:
 - a. Cold Water: White.
 - b. Hot Water: White.
 - c. Fire Protection: White.
- 3.6 VALVE-SCHEDULE INSTALLATION
 - A. Mount valve schedule on wall in accessible location in each major equipment room.
- 3.7 ADJUSTING
 - A. Relocate mechanical identification materials and devices that have become visually blocked by other work.
- 3.8 CLEANING
 - A. Clean faces of mechanical identification devices and glass frames of valve schedules.

SECTION 23 05 93

TESTING, ADJUSTING & BALANCING FOR HVAC

PART 1 - GENERAL

- 1.1 SUMMARY
 - A. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:
 - 1. Balancing airflow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
 - 2. Adjusting total HVAC systems to provide indicated quantities.
 - 3. Measuring electrical performance of HVAC equipment.
 - 4. Setting quantitative performance of HVAC equipment.
 - 5. Verifying that automatic control devices are functioning properly.
 - 6. Reporting results of the activities and procedures specified in this Section.
 - B. Related Sections include the following:
 - 1. Testing and adjusting requirements unique to particular systems and equipment are included in the Sections that specify those systems and equipment.
 - 2. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment Sections.

1.2 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.
- C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- E. Report Forms: Test data sheets for recording test data in logical order.
- F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- K. Test: A procedure to determine quantitative performance of a system or equipment.
- L. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.

- M. AABC: Associated Air Balance Council.
- N. CTI: Cooling Tower Institute.
- O. NEBB: National Environmental Balancing Bureau.
- P. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.3 SUBMITTALS

- A. Quality-Assurance Submittals: Within 30 days from the Contractor's Notice to Proceed, submit 2 copies of evidence that the testing, adjusting, and balancing Agent and this Project's testing, adjusting, and balancing team members meet the qualifications specified in the "Quality Assurance" Article below.
- B. Certified Testing, Adjusting, and Balancing Reports: Submit 2 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.
- C. Warranty: Submit 2 copies of special warranty specified in the "Warranty" Article below.

1.4 QUALITY ASSURANCE

- A. Agent Qualifications for larger projects: Engage a testing, adjusting, and balancing agent certified by AABC.
- B. Agent Qualifications for smaller projects: Engage a testing, adjusting, and balancing agent certified by NEBB.
- C. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
 - 2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.
- D. Testing, Adjusting, and Balancing Reports: Use standard forms from AABC's "National Standards for Testing, Adjusting, and Balancing."
- E. Testing, Adjusting, and Balancing Reports: Use standard forms from NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
- F. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards.
- G. Instrumentation Type, Quantity, and Accuracy: As described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
- H. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.5 PROJECT CONDITIONS

A. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

1.6 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.
- B. Notice: Provide 7 days' advance notice for each test. Include scheduled test dates and times.
- C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.
- 1.7 WARRANTY

- A. General Warranty: The national project performance guarantee specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- PART 2 PRODUCTS (Not Applicable)

PART 3 - EXECUTION

- 3.1 EXAMINATION
 - A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.
 - 1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
 - Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
 - B. Examine approved submittal data of HVAC systems and equipment.
 - C. Examine project record documents described in specifications.
 - D. Examine Architect's and Engineer's design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
 - E. Examine equipment performance data, including fan and pump curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
 - F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
 - G. Examine system and equipment test reports.
 - H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
 - I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
 - J. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
 - K. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible and their controls are connected and functioning.
 - L. Examine equipment for installation and for properly operating safety interlocks and controls.
 - M. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices operate by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.

- Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
- 4. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
- 5. Sensors are located to sense only the intended conditions.
- 6. Sequence of operation for control modes is according to the Contract Documents.
- 7. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
- 8. Interlocked systems are operating.
- 9. Changeover from heating to cooling mode occurs according to design values.
- N. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.
- 3.2 PREPARATION
 - A. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - 1. Permanent electrical power wiring is complete.
 - 2. Automatic temperature-control systems are operational.
 - 3. Equipment and duct access doors are securely closed.
 - 4. Balance, fire dampers are open.
 - 5. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 6. Windows and doors can be closed so design conditions for system operations can be met.
- 3.3 GENERAL TESTING AND BALANCING PROCEDURES
 - A. Perform testing and balancing procedures on each system according to the procedures contained in AABC national standards and this Section.
 - B. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
 - C. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.
 - D. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
- 3.4 FUNDAMENTAL AIR SYSTEMS' BALANCING PROCEDURES
 - A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
 - B. Prepare schematic diagrams of systems' "as-built" duct layouts.
 - C. For variable-air-volume systems, develop a plan to simulate diversity.
 - D. Check the airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
 - E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
 - F. Verify that motor starters are equipped with properly sized thermal protection.
 - G. Check dampers for proper position to achieve desired airflow path.

- H. Check for airflow blockages.
- I. Check condensate drains for proper connections and functioning.
- J. Check for proper sealing of air-handling unit components.
- 3.5 CONSTANT-VOLUME AIR SYSTEMS' BALANCING PROCEDURES
 - A. The procedures in this Article apply to constant-volume supply-, return-, and exhaust-air systems.
 - B. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the fan manufacturer.
 - 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - 2. Measure static pressure across each air-handling unit component.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 - 3. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
 - 4. Adjust fan speed higher or lower than design with the approval of the Architect. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 - 5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure no overload will occur. Measure amperage in full cooling, full heating, and economizer modes to determine the maximum required brake horsepower.
 - C. Adjust volume dampers for main duct, submain ducts, and major branch ducts to design airflows within specified tolerances.
 - 1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
 - a. Where sufficient space in submains and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 - 2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submains and branch ducts to design airflows within specified tolerances.
 - D. Measure terminal outlets and inlets without making adjustments.
 - 1. Measure terminal outlets using a direct-reading hood or the outlet manufacturer's written instructions and calculating factors.
 - E. Adjust terminal outlets and inlets for each space to design airflows within specified tolerances of design values. Make adjustments using volume dampers rather than extractors and the dampers at the air terminals.
 - 1. Adjust each outlet in the same room or space to within specified tolerances of design quantities without generating noise levels above the limitations prescribed by the Contract Documents.

2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer, model, and serial numbers.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating if high-efficiency motor.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.7 CONDENSING UNITS

A. Verify proper rotation of fans and measure entering- and leaving-air temperatures. Record compressor data.

3.8 HEAT-TRANSFER COILS

- A. Electric-Heating Coils: Measure the following data for each coil:
 - 1. Nameplate data.
 - 2. Airflow.
 - 3. Entering- and leaving-air temperatures at full load.
 - 4. Voltage and amperage input of each phase at full load and at each incremental stage.
 - 5. Calculated kW at full load.
 - 6. Fuse or circuit-breaker rating for overload protection.
- 3.9 TEMPERATURE TESTING
 - A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.
 - B. Measure outside-air, wet- and dry-bulb temperatures.

3.10 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Verify free travel and proper operation of control devices such as damper and valve operators.
- F. Verify sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.
- G. Confirm interaction of electrically operated switch transducers.
- H. Confirm interaction of interlock and lockout systems.
- I. Verify main control supply-air pressure and observe compressor and dryer operations.
- J. Record voltages of power supply and controller output. Determine if the system operates on a grounded or nongrounded power supply.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.11 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 - 1. Supply and Exhaust Fans: Plus 5 to plus 10 percent.
 - 2. Air Outlets and Inlets: 0 to minus 10 percent.
 - 3. Cooling-Water Flow Rate: 0 to minus 5 percent.

3.12 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 - 1. Include a list of the instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to the certified field report data, include the following:
 - 1. Fan curves.
 - 2. Manufacturers' test data.
 - 3. Field test reports prepared by system and equipment installers.
 - 4. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.
- D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:
 - 1. Title page.
 - 2. Name and address of testing, adjusting, and balancing Agent.
 - 3. Project name.
 - 4. Project location.
 - 5. Architect's name and address.
 - 6. Engineer's name and address.
 - 7. Contractor's name and address.
 - 8. Report date.
 - 9. Signature of testing, adjusting, and balancing Agent who certifies the report.
 - 10. Summary of contents, including the following:
 - a. Design versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 - 11. Nomenclature sheets for each item of equipment.
 - 12. Data for terminal units, including manufacturer, type size, and fittings.
 - 13. Notes to explain why certain final data in the body of reports vary from design values.
 - 14. Test conditions for fans and pump performance forms, including the following:
 - a. Settings for outside-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings, including settings and percentage of maximum pitch diameter.
 - f. Settings for supply-air, static-pressure controller.
 - g. Other system operating conditions that affect performance.
- E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present with single-line diagrams and include the following:

- 1. Quantities of outside, supply, return, and exhaust airflows.
- 2. Water and steam flow rates.
- 3. Duct, outlet, and inlet sizes.
- 4. Pipe and valve sizes and locations.
- 5. Terminal units.
- 6. Balancing stations.
- F. Roof Top Unit Test Reports: For air-handling units with coils, include the following:
 - 1. Unit Data: Include the following:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches (mm), and bore.
 - i. Number of belts, make, and size.
 - j. Number of filters, type, and size.
 - 2. Motor Data: Include the following:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - 3. Test Data: Include design and actual values for the following:
 - a. Total airflow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Preheat coil static-pressure differential in inches wg (Pa).
 - f. Cooling coil static-pressure differential in inches wg (Pa).
 - g. Heating coil static-pressure differential in inches wg (Pa).
 - h. Outside airflow in cfm (L/s).
 - i. Return airflow in cfm (L/s).
 - j. Outside-air damper position.
 - k. Return-air damper position.
 - I. Discharge air temperature
- G. Electric-Coil Test Reports: For electric duct coils, and electric coils installed in central-station air-handling units, include the following:
 - 1. Unit Data: Include the following:
 - a. System identification.
 - b. Location.
 - c. Coil identification.
 - d. Capacity in Btuh (kW).
 - e. Number of stages.

- f. Connected volts, phase, and hertz.
- g. Rated amperage.
- h. Discharge air temperature
- 2. Test Data: Include design and actual values for the following:
 - a. Heat output in Btuh (kW).
 - b. Airflow rate in cfm (L/s).
 - c. Air velocity in fpm (m/s).
 - d. Entering-air temperature in deg F (deg C).
 - e. Leaving-air temperature in deg F (deg C).
 - f. Voltage at each connection.
 - g. Amperage for each phase.
- H. Fan Test Reports: For exhaust fans, include the following:
 - 1. Fan Data: Include the following:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - 2. Motor Data: Include the following:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Number of belts, make, and size.
 - 3. Test Data: Include design and actual values for the following:
 - a. Total airflow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Suction static pressure in inches wg (Pa).
- I. Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, aircooled condensing units, include the following:
 - 1. Unit Data: Include the following:
 - a. Unit identification.
 - b. Location.
 - c. Unit make and model number.
 - d. Manufacturer's compressor serial numbers.
 - e. Compressor make.
 - f. Compressor model and serial numbers.
 - g. Refrigerant weight in lb (kg).
 - 2. Test Data: Include design and actual values for the following:
 - a. Entering-air, dry-bulb temperature in deg F (deg C).
 - b. Leaving-air, dry-bulb temperature in deg F (deg C).

- c. Control settings.
- d. Unloader set points.
- e. Low-pressure-cutout set point in psig (kPa).
- f. High-pressure-cutout set point in psig (kPa).
- g. Suction pressure in psig (kPa).
- h. Suction temperature in deg F (deg C).
- i. Condenser refrigerant pressure in psig (kPa).
- j. Condenser refrigerant temperature in deg F (deg C).
- k. Oil pressure in psig (kPa).
- I. Oil temperature in deg F (deg C).
- m. Voltage at each connection.
- n. Amperage for each phase.
- o. The kW input.
- p. Number of fans.

3.13 ADDITIONAL TESTS

A. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

SECTION 23 07 13

DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes semirigid and flexible duct, plenum, and breeching insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.
- 1.2 SUBMITTALS
 - A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.
- 1.4 DELIVERY, STORAGE, AND HANDLING
 - A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.
 - B. Deliver and store all insulation with protective material until installation. Any material left exposed to moisture and/or particulates shall be removed and replaced.
 - C. Any installed insulation left temporarily incomplete shall be covered with protective material until final connections can be installed.

1.5 COORDINATION

- A. Coordinate clearance requirements with duct Installer for insulation application.
- 1.6 SCHEDULING
 - A. Schedule insulation application after testing duct systems. Insulation application may begin on segments of ducts that have satisfactory test results.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Mineral-Fiber Insulation:
 - a. CertainTeed Manson.
 - b. Knauf FiberGlass GmbH.
 - c. Owens-Corning Fiberglas Corp.
 - d. Schuller International, Inc.
- 2.2 INSULATION MATERIALS
 - A. Mineral-Fiber Blanket Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II, with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film
- 2.3 Field Applied Jacket
 - A. Foil and paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.
- 2.4 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd. (270 g/sq. m).
 1. Tape Width: 4 inches (100 mm).
- B. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.
 - 1. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, plenums, and breechings; and to achieve a holding capacity of 100 lb (45 kg) for direct pull perpendicular to the adhered surface.

2.5 VAPOR RETARDERS

A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

- 3.1 EXAMINATION
 - A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 - B. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.2 PREPARATION
 - A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- 3.3 GENERAL APPLICATION REQUIREMENTS
 - A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of ducts and fittings.
 - B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each duct system.
 - C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
 - D. Apply multiple layers of insulation with longitudinal and end seams staggered.
 - E. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
 - F. Keep insulation materials dry during application and finishing.
 - G. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
 - H. Apply insulation with the least number of joints practical.
 - I. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 - J. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic. Apply insulation continuously through hangers and around anchor attachments.
 - K. Insulation Terminations: For insulation application where vapor retarders are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
 - L. Apply insulation with integral jackets as follows:
 - 1. Pull jacket tight and smooth.
 - 2. Joints and Seams: Cover with tape and vapor retarder as recommended by insulation material manufacturer to maintain vapor seal.
 - 3. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to duct flanges and fittings.
 - M. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.
 - N. Install vapor-retarder mastic on ducts and plenums scheduled to receive vapor retarders.

- 1. Ducts with Vapor Retarders: Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-retarder seal.
- 2. Ducts without Vapor Retarders: Overlap insulation facing at seams and secure with outward clinching staples and pressure-sensitive tape having same facing as insulation.
- O. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
 - 1. Seal penetrations with vapor-retarder mastic.
 - 2. Apply insulation for exterior applications tightly joined to interior insulation ends.
 - 3. Seal insulation to roof flashing with vapor-retarder mastic.
- P. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.
- Q. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for firerated wall and partition penetrations.
- R. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.
 - 1. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.
- 3.4 MINERAL-FIBER INSULATION APPLICATION
 - A. Blanket Applications for Ducts and Plenums: Secure blanket insulation with adhesive and anchor pins and speed washers.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct and plenum surfaces.
 - 2. Install anchor pins and speed washers on sides and bottom of horizontal ducts and all sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches (450 mm) and smaller, along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (450 mm). Space 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
 - c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - 3. Impale insulation over anchors and attach speed washers.
 - 4. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 - 5. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch (13-mm) staples, 1 inch (25 mm) o.c., and cover with pressure-sensitive tape having same facing as insulation.
 - 6. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 inches (450 mm) o.c.
 - 7. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Apply insulation on round duct elbows with individually mitered gores cut to fit the elbow.
 - 8. Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch-(150-mm-) wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches (150 mm) o.c.
 - 9. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

3.5 DUCT SYSTEM APPLICATIONS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.
- B. Materials and thicknesses for systems listed below are specified in schedules at the end of this Section.
- C. Insulate the following plenums and duct systems:

- 1. Indoor concealed supply-, return-, and outside-air ductwork.
- 2. Indoor exposed supply-, return-, and outside-air ductwork.
- 3. Indoor concealed range-hood exhaust ductwork.
- 4. Indoor concealed dishwasher ductwork.
- D. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
 - 1. Factory-insulated flexible ducts.
 - 2. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections.
 - 3. Flexible connectors.
 - 4. Vibration-control devices.
 - 5. Testing agency labels and stamps.
 - 6. Nameplates and data plates.
 - 7. Access panels and doors in air-distribution systems.
- 3.6 INDOOR DUCT AND PLENUM APPLICATION SCHEDULE
 - A. Service: Round and rectangular, supply-air ducts, concealed.
 - 1. Material: Mineral-fiber blanket.
 - 2. Thickness: 3 inches (R-8 or greater)
 - 3. Number of Layers: One.
 - 4. Field-Applied Jacket: Foil and paper.
 - 5. Vapor Retarder Required: Yes.
 - B. Service: Round and rectangular, return-air ducts, outside air duct, concealed or exposed.
 - 1. Material: Mineral-fiber blanket.
 - 2. Thickness: 2 inches (50 mm).
 - 3. Number of Layers: One.
 - 4. Field-Applied Jacket: Foil and Paper
 - 5. Vapor Retarder Required: Yes.
 - C. Service: Round and rectangular, supply and return-air ducts, exposed and in mechanical rooms.
 - 1. Material: 2" liner insulation
 - 2. Thickness: 2 inches (50 mm).
 - 3. Number of Layers: One.
 - 4. Field-Applied Jacket: None.
 - 5. Vapor Retarder Required: No
 - D. Service: Round and rectangular, exhaust air ducts, concealed & exposed and in mechanical rooms.
 - 1. Material: 1" Interior liner
 - 2. Thickness: 1 inches
 - 3. Number of Layers: One.
 - 4. Field-Applied Jacket: None.
 - 5. Vapor Retarder Required: No

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SECTION 23 23 00

REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Furnish and install piping and specialties for refrigeration systems as described in Contract Documents.
- B. Products Installed But Not Furnished Under This Section:

1.2 REFERENCES

- A. Association Publications:
 - 1. Federal Emergency Management Agency (FEMA) / Vibration Isolation and Seismic Control Manufacturers Association (VISCMA) / American Society of Civil Engineers (ASCE):
 - a. FEMA 412, 'Installing Seismic Restraints For Mechanical Equipment' (December 2002).
 - 2. Vibration Isolation and Seismic Control Manufacturers Association (VISCMA):
 - a. VISCMA 101-12, 'Seismic Restraint Specification Guidelines for Mechanical, Electrical, and Plumbing Systems'.
 - b. VISCMA 102-12, 'Vibration Isolation Specification Guidelines for Mechanical, Electrical, and Plumbing Systems'.
- B. Definitions:
 - 1. Refrigerant: Absorbs heat by a change of state (evaporation) from liquid to a gas, and releases heat by a change of state (condenses) from gas back to a liquid.

- 2. Vibration Isolation: Vibration reduction in which an isolation system is placed between the source of unwanted vibration and an item which needs to be shielded from the vibration.
- C. Reference Standards:
 - 1. American National Standards Institute (ANSI) / American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - a. ANSI/ASHRAE Standard 15-2010, 'Safety Standard for Refrigeration Systems'.
 - b. ANSI/ASHRAE Standard 34-2010, 'Designation and Classification of Refrigerants'.
 - 2. American National Standards Institute / American Welding Society:
 - a. ANSI/AWS A5.8M/A5.8-2011, 'Specification for Filler Metals for Brazing and Braze Welding'.
 - 3. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - a. '2011 ASHRAE Handbook HVAC Applications'.
 - 1) Chapter 48, 'Noise and Vibration Control'.
 - 4. ASTM International:
 - a. ASTM A36/A36M-08, 'Standard Specification for Carbon Structural Steel'.
 - b. ASTM B280-08, 'Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service'.
 - 5. National Fire Protection Association / American National Standards Institute:
- a. NFPA 90A-2012, 'Installation of Air Conditioning and Ventilating Systems'.
- 6. Underwriters Laboratories:
 - a. UL 2182, 'Refrigerants' (2nd Edition).
- 1.3 SUBMITTALS
 - A. Action Submittals:
 - 1. Shop Drawings: Show each individual equipment and piping support.
 - B. Informational Submittals:
 - 1. Qualification Statements: Technician certificate for use of HFC and HCFC refrigerants.
- 1.4 QUALITY ASSURANCE
 - A. Regulatory Agency Sustainability Approvals:
 - 1. Refrigerants:
 - a. Underwriters Laboratories / Underwriters Laboratories of Canada:
 - 1) Comply with requirements of UL 2182.
 - B. Qualifications. Section 01 4301 applies, but is not limited to the following:
 - 1. Installer: Refrigerant piping shall be installed by refrigeration contractor licensed by State and by technicians certified in use of HFC and HCFC refrigerants.

PART 2 - PRODUCTS

- 2.1 COMPONENTS
 - A. Manufacturers:
 - 1. Manufacturer Contact List:
 - a. Airtec,
 - b. Cush-A-Clamp by ZSI Manufacturing,
 - c. Elkhart Products Corp,.
 - d. Emerson Climate Technologies,
 - e. Handy & Harman Products
 - f. Harris Products Group,
 - g. Henry Valve Co,
 - h. Hilti Inc,
 - i. Hydra-Zorb Co,
 - j. JB Industries,
 - k. Mueller Steam Specialty,
 - I. Nibco Inc,
 - m. Packless Industries, Parker Corp,
 - n. Sporlan Valve Co.
 - o. Sherwood Valves,.
 - p. Thomas & Betts,
 - q. Unistrut, Div of Atkore International, Inc.
 - r. Universal Metal Hose.
 - s. Vibration Mountings & Controls,
 - t. Virginia KMP Corp,
 - B. Materials:
 - 1. Refrigerant Piping:
 - a. Meet requirements of ASTM B280, hard drawn straight lengths. Soft copper tubing not permitted.
 - b. Do not use pre-charged refrigerant lines.

- 2. Refrigerant Fittings:
 - a. Wrought copper with long radius elbows.
 - b. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
 - 1) Mueller Streamline.
 - 2) Nibco Inc.
 - 3) Elkhart.
- 3. Suction Line Traps:
 - a. Manufactured standard one-piece traps.
 - b. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
 - 1) Mueller Streamline.
 - 2) Nibco Inc.
 - 3) Elkhart.
- 4. Tee Access:
 - a. Brass:
 - 1) Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
 - a) JB Industries: Part #A3 Series with Factory Cap and Valve Core.
- 5. Connection Material:
 - a. Brazing Rods in accordance with ANSI/AWS A5.8M/A5.8:
 - 1) Copper to Copper Connections:
 - a) Classification BCuP-4 Copper Phosphorus (6 percent silver).
 - b) Classification BCuP-5 Copper Phosphorus (15 percent silver).
 - 2) Copper to Brass or Copper to Steel Connections: Classification BAg-5 Silver (45 percent silver).
 - 3) Do not use rods containing Cadmium.
 - b. Flux:
 - 1) Type Two Acceptable Products:
 - a) Stay-Silv White Brazing Flux by Harris Products Group.
 - b) High quality silver solder flux by Handy & Harmon.
 - c) Equal as approved by Architect before use. See Section 01 6200.
- 6. Valves:
 - a. Expansion Valves:
 - 1) For pressure type distributors, externally equalized with stainless steel diaphragm, and same refrigerant in thermostatic elements as in system.
 - 2) Size valves to provide full rated capacity of cooling coil served. Coordinate selection with evaporator coil and condensing unit.
 - 3) Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
 - a) Emerson Climate Technologies.
 - b) Henry.
 - c) Mueller.
 - d) Parker.
 - e) Sporlan.
 - b. Manual Refrigerant Shut-Off Valves:
 - 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 service valves come as integral part of condensing unit, additional service valves shall not be required.
- 6) Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
 - a) Henry.
 - b) Mueller.
 - c) Sherwood.
 - d) Virginia.
- 7. Filter-Drier:
 - a. On lines 3/4 inch (19 mm) outside diameter and larger, filter-drier shall be replaceable core type with Schraeder type valve.
 - b. On lines smaller than 3/4 inch (19 mm) outside diameter, filter-drier shall be sealed type with brazed end connections.
 - c. Size shall be full line size.
 - d. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
 - 1) Emerson Climate Technologies.
 - 2) Mueller.
 - 3) Parker.
 - 4) Sporlan.
 - 5) Virginia.
- 8. Sight Glass:
 - a. Combination moisture and liquid indicator with protection cap.
 - b. Sight glass shall be full line size.
 - c. Sight glass connections and sight glass body shall be solid copper or brass, no copper-coated steel sight glasses allowed.
 - d. Category Four Approved Product. See Section 01 6200 for definitions of Categories:
 - 1) HMI by Emerson Climate Technologies.
- 9. Flexible Connectors:
 - a. Designed for refrigerant service with bronze seamless corrugated hose and bronze braiding.
 - b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - 1) Vibration Absorber Model VAF by Packless Industries.
 - 2) Vibration Absorbers by Virginia KMP Corp.
 - 3) Anaconda 'Vibration Eliminators' by Universal Metal Hose.
 - 4) Style 'BF' Spring-flex freon connectors by Vibration Mountings.
- 10. Refrigerant Piping Supports:
 - a. Base, Angles, And Uprights: Steel meeting requirements of ASTM A36.
 - b. Securing Channels:
 - 1) At Free-Standing Pipe Support:
 - a) Class One Quality Standard: P-1000 channels by Unistrut.
 - b) Acceptable Manufacturers: Hilti, Thomas & Betts.
 - c) Equal as approved by Architect before installation. See Section 01 6200.
 - 2) At Wall Support:
 - a) Class One Quality Standard: P-3300 channels by Unistrut.

- b) Acceptable Manufacturers: Hilti, Thomas & Betts.
- c) Equal as approved by Architect before installation. See Section 01 6200.
- 3) At Suspended Support:
 - a) Class One Quality Standard: P-1001 channels by Unistrut.
 - b) Acceptable Manufacturers: Hilti, Thomas & Betts.
 - c) Equal as approved by Architect before installation. See Section 01 6200.
- 4) Angle Fittings:
 - a) Class One Quality Standard: P-2626 90 degree angle by Unistrut.
 - b) Acceptable Manufacturers: Hilti, Thomas & Betts.
 - c) Equal as approved by Architect before installation. See Section 01 6200.
- c. Pipe Clamps:
 - 1) Type Two Acceptable Manufacturers:
 - a) Hydra-Zorb.
 - b) ZSI Cush-A-Clamp.
 - c) Hilti Cush-A-Clamp.
 - d) Equal as approved by Architect before installation. See Section 01 6200.
- d. Protective Cover: 18 ga (1.2 mm) steel, hot-dipped galvanized.
- 11. Locking Refrigerant Cap:
 - a. Provide and install on charging valves:
 - 1) Class One Quality Standard: 'No Vent' locking refrigerant cap.
 - 2) Acceptable Manufacturers: Airtec.
 - 3) Equal as approved by Architect before installation. See Section 01 6200.

PART 3 - EXECUTION

- 3.1 INSTALLATION
 - A. Refrigerant Lines:
 - 1. Install as high in upper mechanical areas as possible. Do not install underground or in tunnels.
 - 2. Slope suction lines down toward compressor one inch/10 feet (25 mm in 3 meters). Locate traps at vertical rises against flow in suction lines.
 - B. Connections:
 - 1. Refrigeration system connections shall be copper-to-copper, copper-to-brass, or copper-to-steel type properly cleaned and brazed with specified rods. Use flux only where necessary. No soft solder (tin, lead, antimony) connections will be allowed in system.
 - 2. Braze manual refrigerant shut-off valve, sight glass, and flexible connections.
 - 3. Circulate dry nitrogen through tubes being brazed to eliminate formation of copper oxide during brazing operation.
 - C. Specialties:
 - 1. Install valves and specialties in accessible locations. Install refrigeration distributors and suction outlet at same end of coil.
 - 2. Install thermostatic bulb as close to cooling coil as possible. Do not install on vertical lines.
 - 3. Install equalizing line in straight section of suction line, downstream of and reasonably close to thermostatic bulb. Do not install on vertical lines.
 - 4. Provide flexible connectors in each liquid line and suction line at both condensing unit and evaporator on systems larger than five tons. Anchor pipe near each flexible connector.
 - D. Refrigerant Supports:

- 1. Support Spacing:
 - a. Piping 1-1/4 inch (32 mm) And Larger: 8 feet (2.450 m) on center maximum.
 - b. Piping 1-1/8 inch (28.5 mm) And Smaller: 6 feet (1.80 m) on center maximum.
 - c. Support each elbow.
- 2. Isolate pipe from supports and clamps with Hydrozorb or Cush-A-Clamp systems.
- 3. Run protective cover continuous from condensing units to risers or penetrations at building wall.
- 3.2 FIELD QUALITY CONTROL
 - A. Field Tests:
 - 1. Make evacuation and leak tests in presence of Architect's Engineer after completing refrigeration piping systems. Positive pressure test will not suffice for procedure outlined below.
 - a. Draw vacuum on each entire system with two stage vacuum pump. Draw vacuum to 300 microns using micron vacuum gauge capable of reading from atmosphere to 10 microns. Do not use cooling compressor to evacuate system nor operate it while system is under high vacuum.
 - b. Break vacuum with nitrogen and re-establish vacuum test. Vacuum shall hold for 30 minutes at 300 microns without vacuum pump running.
 - c. Conduct tests at 70 deg F (21 deg C) ambient temperature minimum.
 - d. Do not run systems until above tests have been made and systems started up as specified. Inform Owner's Representative of status of systems at time of final inspection and schedule start-up and testing if prevented by outdoor conditions before this time.
 - e. After testing, fully charge system with refrigerant and conduct test with Halide Leak Detector.
 - f. Recover all refrigerant in accordance with applicable codes. Do not allow any refrigerant to escape to atmosphere.
 - B. Non-Conforming Work:
 - 1. If it is observed that refrigerant lines are being or have been brazed without proper circulation of nitrogen through lines, all refrigerant lines installed up to that point in time shall be removed and replaced at no additional cost to Owner.

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SECTION 23 26 00

CONDENSATE DRAIN PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Coordinate installation of condensate drain piping with Section 22 0501 as described in Contract Documents.

1.2 REFERENCES

- A. Reference Standards:
 - 1. ASTM International:
 - a. ASTM B88-09, 'Standard Specification for Seamless Copper Water Tube'.
 - b. ASTM D1785-12, 'Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120'.

PART 2 - PRODUCTS

- 2.1 SYSTEMS
 - A. Materials:
 - 1. Condensate Drains:
 - a. Exterior And Interior Lines: Type M copper meeting requirements of ASTM B88.

PART 3 - EXECUTION

- 3.1 INSTALLATION
 - A. Condensate Drains:
 - 1. Support piping and protect from damage.

SECTION 23 31 13

METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions.
- 1.2 SUMMARY
 - B. This Section includes rectangular, round, and flat-oval metal ducts and plenums for heating, ventilating, and air-conditioning systems in pressure classes from minus 2- to plus 10-inch wg

1.3 DEFINITIONS

- A. Thermal Conductivity and Apparent Thermal Conductivity (k-Value): As defined in ASTM C 168. In this Section, these values are the result of the formula Btu x in./h x sq. ft. x deg F or W/m x K at the temperature differences specified. Values are expressed as Btu or W.
- 1.4 SYSTEM DESCRIPTION
 - A. Duct system design, as indicated, has been used to select and size air-moving and -distribution equipment and other components of air system. Changes to layout or configuration of duct system must be specifically approved in writing by Architect.

1.5 SUBMITTALS

- A. Product Data: For duct liner and sealing materials.
- B. Shop Drawings: Show details of the following:
 - 1. Duct layout indicating pressure classifications and sizes on plans.
 - 2. Fittings.
 - 3. Penetrations through fire-rated and other partitions.
 - 4. Coordination with other trades and including but not limited to: structural members, electrical lights and conduits, plumbing lines, & fire sprinkler lines.
- C. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceilingmounted items. Show the following:
 - 1. Ceiling- and wall-mounted access doors and panels required to provide access to dampers and other operating devices.
 - 2. Coordination with ceiling-mounted items, including lighting fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.
- D. Duct Construction Standards: Provide a copy of the duct construction standards to be used for each pressure classification in this project. Duct Construction Standards must comply with the latest edition of SMACNA "HVAC Duct Construction Standards Metal and Flexible."
- E. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- F. Record Drawings: Indicate actual routing, fitting details, reinforcement, support, and installed accessories and devices.
- 1.6 QUALITY ASSURANCE
 - A. Welding Standards: Qualify welding procedures and welding personnel to perform welding processes for this Project according to AWS D1.1, "Structural Welding Code--Steel," for hangers and supports;

AWS D1.2, "Structural Welding Code--Aluminum," for aluminum supporting members; and AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

- B. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," unless otherwise indicated.
- C. Comply with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems," unless otherwise indicated.
- D. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Chapter 3, "Duct System," for range hood ducts, unless otherwise indicated.
- 1.7 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver sealant and firestopping materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.
 - B. Store and handle sealant and firestopping materials according to manufacturer's written recommendations.
 - C. Deliver and store stainless-steel sheets with mill-applied adhesive protective paper maintained through fabrication and installation
 - D. Deliver and store all ductwork with protective material until installation. Any material left exposed to moisture and/or particulates shall be removed and replaced.
 - E. Any installed ductwork or piping system left temporarily incomplete shall be covered with protective material until final connections can be installed.
 - F. All ductwork and/or liner insulation to be wrapped with protective material until installation. Any ductwork or insulation left exposed to the environment or contaminating particulate matter shall be replaced at the contractor's expense.

PART 2 - PRODUCTS

- 2.1 SHEET METAL MATERIALS
 - A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 (Z275) coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.
 - B. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; with oiled, exposed matte finish.
 - C. Stainless Steel: ASTM A 480/A 480M, Type 316, sheet form with No. 4 finish for surfaces of ducts exposed to view; and Type 304, sheet form with No. 1 finish for concealed ducts.
 - D. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
 - E. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for 36-inch (900-mm) length or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.2 SEALANT MATERIALS

- A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.
 - 1. Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant, formulated with a minimum of 75 percent solids.
 - 2. Flanged Joint Mastics: One-part, acid-curing, silicone, elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.
- 2.3 HANGERS AND SUPPORTS

- A. Hanger Materials: Galvanized, sheet steel or round, threaded steel rod.
 - 1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rod or galvanized rods with threads painted after installation.
 - 2. Straps and Rod Sizes: Comply with latest edition of SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for sheet steel width and thickness and for steel rod diameters.
- B. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- C. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
 - 1. Supports for Galvanized-Steel Ducts: Galvanized steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
 - 3. Supports for Aluminum Ducts: Aluminum support materials, unless materials are electrolytically separated from ductwork.

2.4 RECTANGULAR DUCT FABRICATION

- General: Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction with galvanized, sheet steel, according to the latest edition of SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Comply with requirements for metal thickness, reinforcing types and intervals, tierrod applications, and joint types and intervals.
 - 1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
 - 2. Materials: Free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.
- B. Fabricate range hood exhaust ducts with 0.0598-inch- thick, galvanized sheet for concealed ducts and 0.0500-inch- thick stainless steel for exposed ducts. Weld and flange seams and joints. Comply with NFPA 96.
- C. Fabricate dishwasher hood exhaust ducts with 0.0500-inch- thick stainless steel. Weld and flange seams and joints.
- D. Static-Pressure Classifications: Unless otherwise indicated, construct ducts to the following:
 - 1. Supply Ducts between AHU and Air Terminal Units: 3-inch wg.
 - 2. Supply Ducts after air terminal units and on constant volume supply equipment: 1-inch wg (250 Pa), positive pressure
 - 3. Return Ducts: 1-inch wg ,negative pressure.
 - 4. Exhaust Ducts: 1-inch wg negative pressure.
- E. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of unbraced panel area, unless ducts are lined.

2.5 ROUND FABRICATION

- A. Round Ducts: Fabricate spiral seam supply and return ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Snap Lock Longitudinal seam ductwork will not be allowed. Adjustable elbows will not be allowed.
- B. Spiral seam round or oval duct may be substituted for rectangular duct at the contractors option. Spiral seam ductwork sizing must result in the same or less pressure drop than the rectangular duct indicated on the plans.
- 2.6 DUCT STORGE

A. All duct must have end capped with plastic covers on both ends from end of fabrication to duct installation. If this is not provided at the field, vacuum ducts before final acceptance to remove dust and debris.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION, GENERAL

- A. Duct installation requirements are specified in other Division Sections. Drawings indicate general arrangement of ducts, fittings, and accessories.
- B. Construct and install each duct system for the specific duct pressure classification indicated.
- C. Install round ducts in lengths not less than 10 feet (3 m), unless interrupted by fittings.
- D. Install ducts with fewest possible joints.
- E. Install fabricated fittings for changes in directions, changes in size and shape, and connections.
- F. Install couplings tight to duct wall surface with a minimum of projections into duct.
- G. Install ducts, unless otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs.
- H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- I. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.
- J. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions, unless specifically indicated.
- K. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
- L. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same metal thickness as duct. Overlap opening on four sides by at least 1-1/2 inches (38 mm).
- N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire damper, sleeve, and firestopping sealant. Fire and smoke dampers are specified in Division Section "Duct Accessories." Firestopping materials and installation methods are specified in other Divisions

3.2 SEAM AND JOINT SEALING

- A. General: Seal duct seams and joints according to the duct pressure class indicated and as described in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." All duct to be sealed to SMACNA seal class A which requires sealing all transverse joints, longitudinal seams and duct wall penetrations regardless of pressure classification.
- B. Seal externally insulated ducts before insulation installation.
- C. All ducts shall be inspected after sealing is complete and prior to insulation installation. Provide the engineer with a minimum 7 days notice prior to beginning duct insulation.
- 3.3 RANGE HOOD EXHAUST DUCT INSTALLATIONS
 - A. Install ducts to allow for thermal expansion of ductwork through 2000 deg F temperature range.
 - B. Install ducts without dips or traps that may collect residues, unless traps have continuous or automatic residue removal.

- C. Install access openings at each change in direction and at 15-foot intervals; locate on sides of duct a minimum of 1-1/2 inches from bottom; and fit with grease-tight covers of same material as duct.
- D. Do not penetrate fire-rated assemblies.
- 3.4 DISHWASHER EXHAUST DUCT INSTALLATIONS
 - A. Install dishwasher exhaust ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- 3.5 HANGING AND SUPPORTING
 - A. Install rigid round and rectangular metal duct with support systems indicated in the latest edition of SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
 - B. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.
 - C. Support vertical ducts at a maximum interval of 16 feet and at each floor.
 - D. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
- 3.6 CONNECTIONS
 - A. Connect equipment with flexible connectors according to Section "Duct Accessories."
 - B. For branch, outlet and inlet, and terminal unit connections, comply with the latest edition of SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- 3.7 DUCT APPLICATION
 - A. Service: Round and rectangular, supply/return/outside -air ducts, concealed.
 - B. Sheet-metal with wrap insulation
 - C. Service: Round and rectangular, supply/return/outside -air ducts, exposed and in mechanical rooms.
 - 1. Sheet-metal double wall with lined insulation in-between.
 - 2. Inner sheet-metal duct shall be perforated in areas with acoustical requirements, ref. plans.
- 3.8 FIELD QUALITY CONTROL
 - A. Disassemble, reassemble, and seal segments of systems as required to accommodate leakage testing and as required for compliance with test requirements.
 - B. 25% of the duct installed after the air handling units and (prior to the air terminal units, when applicable) shall be tested in the presence of the Architect, at static pressures equal to maximum design pressure of system or section being tested. The sections of duct to be tested shall be chosen by the architect or engineer after installation of the duct. If pressure classifications are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
 - C. Leakage Test: Perform tests according to SMACNA's "HVAC Air Duct Leakage Test Manual."
 - D. Maximum Allowable Leakage: Comply with requirements for Leakage Classification 3 for round, Leakage Classification 12 for rectangular ducts in pressure classifications less than and equal to 2-inch wg (both positive and negative pressures), and Leakage Classification 6 for pressure classifications from 2- to 10-inch wg.
 - E. Remake leaking joints and retest until leakage is less than maximum allowable.
- 3.9 CLEANING
 - A. After completing system installation, including outlet fittings and devices, inspect the system.

SECTION 23 33 00

HVAC DUCT ACCESSORIES

PART 1 - GENERAL

- 1.1 SUMMARY
 - A. This Section includes the following:
 - 1. Backdraft dampers.
 - 2. Manual-volume dampers.
 - 3. Fire dampers.
 - 4. Turning vanes.
 - 5. Duct-mounted access doors and panels.
 - 6. Flexible ducts.
 - 7. Flexible connectors.
 - 8. Duct accessory hardware.

1.2 SUBMITTALS

- A. Product Data: For the following:
 - 1. Backdraft dampers.
 - 2. Manual-volume dampers.
 - 3. Fire dampers.
 - 4. Duct-mounted access doors and panels.
 - 5. Flexible ducts.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, location, and size of each field connection. Detail the following:
 - 1. Special fittings and manual- and automatic-volume-damper installations.
 - 2. Fire-damper installations, including sleeves and duct-mounted access doors and panels.
- C. Product Certificates: Submit certified test data on dynamic insertion loss; self-noise power levels; and airflow performance data, static-pressure loss, dimensions, and weights.

1.3 QUALITY ASSURANCE

- A. NFPA Compliance: Comply with the following NFPA standards:
 - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
 - 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- 1.4 EXTRA MATERIALS
 - A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

- 2.1 SHEET METAL MATERIALS
 - A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 (Z275) coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.
 - B. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets, commercial quality, with oiled, exposed matte finish.

- C. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for 36-inch (900-mm) length or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.2 BACKDRAFT DAMPERS

- A. Description: Suitable for horizontal or vertical installations.
- B. Frame: 0.052-inch- (1.3-mm-) thick, galvanized, sheet steel, with welded corners and mounting flange.
- C. Blades: 0.025-inch- (0.6-mm-) thick, roll-formed aluminum.
- D. Blade Seals: Vinyl.
- E. Blade Axles: Galvanized steel.
- F. Tie Bars and Brackets: Galvanized steel.
- G. Return Spring: Adjustable tension.
- 2.3 MANUAL-VOLUME DAMPERS
 - A. General: Factory fabricated with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
 - B. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
 - 1. Steel Frames: Hat-shaped, galvanized, sheet steel channels, minimum of 0.064 inch (1.62 mm) thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
 - 2. Roll-Formed Steel Blades: 0.064-inch- (1.62-mm-) thick, galvanized, sheet steel.
 - 3. Blade Axles: Galvanized steel.
 - 4. Tie Bars and Brackets: Galvanized steel.
 - C. Jackshaft: 1-inch- (25-mm-) diameter, galvanized steel pipe rotating within a pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 - 1. Length and Number of Mountings: Appropriate to connect linkage of each damper of a multipledamper assembly.
 - D. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.
- 2.4 FIRE DAMPERS
 - A. General: Labeled to UL 555.
 - B. Fire Rating: One and one-half hours.
 - C. Fire Rating: One and one-half hours.
 - D. Frame: SMACNA Type B with blades out of airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.
 - E. Mounting Sleeve: Factory- or field-installed galvanized, sheet steel.
 - 1. Minimum Thickness: 0.052 inch (1.3 mm) or 0.138 inch (3.5 mm) thick as indicated, and length to suit application.
 - 2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.

- F. Mounting Orientation: Vertical or horizontal as indicated.
- G. Blades: Roll-formed, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized, sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized steel blade connectors.
- H. Horizontal Dampers: Include a blade lock and stainless-steel negator closure spring.
- I. Fusible Link: Replaceable, 165 deg F (74 deg C) rated as indicated.

2.5 TURNING VANES

- A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Acoustic Turning Vanes: Fabricate of airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- 2.6 DUCT-MOUNTED ACCESS DOORS AND PANELS
 - A. General: Fabricate doors and panels airtight and suitable for duct pressure class.
 - B. Frame: Galvanized, sheet steel, with bend-over tabs and foam gaskets.
 - C. Door: Double-wall, galvanized, sheet metal construction with insulation fill and thickness, and number of hinges and locks as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.
 - D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.
 - E. Insulation: 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board.
- 2.7 FLEXIBLE CONNECTORS
 - A. General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
 - B. Standard Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches (89 mm) wide attached to two strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized, sheet steel or 0.032-inch (0.8-mm) aluminum sheets. Select metal compatible with connected ducts.
 - C. Extra-Wide Metal-Edged Connectors: Factory fabricated with a strip of fabric 5-3/4 inches (146 mm) wide attached to two strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized, sheet steel or 0.032-inch (0.8-mm) aluminum sheets. Select metal compatible with connected ducts.
 - D. Transverse Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches (89 mm) wide attached to two strips of 4-3/8-inch- (111-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized, sheet steel or 0.032-inch (0.8-mm) aluminum sheets. Select metal compatible with connected ducts.
 - E. Conventional, Indoor System Flexible Connector Fabric: Glass fabric double coated with polychloroprene.
 - 1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
 - 2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp, and 360 lbf/inch (63 N/mm) in the filling.
 - F. Conventional, Outdoor System Flexible Connector Fabric: Glass fabric double coated with a syntheticrubber, weatherproof coating resistant to the sun's ultraviolet rays and ozone environment.
 - 1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
 - 2. Tensile Strength: 530 lbf/inch (93 N/mm) in the warp, and 440 lbf/inch (77 N/mm) in the filling.
- 2.8 FLEXIBLE DUCTS
 - A. General: Comply with UL 181, Class 1.
 - B. Flexible Ducts, Insulated: Factory-fabricated, insulated, round duct, with an outer jacket enclosing 1-1/2inch- (38-mm-) thick, glass-fiber insulation around a continuous inner liner.
 - 1. Reinforcement: Steel-wire helix encapsulated in inner liner.
 - 2. Outer Jacket: Polyethylene film.
 - 3. Inner Liner: Polyethylene film.

- C. Pressure Rating: 6-inch wg (1500 Pa) positive, 1/2-inch wg (125 Pa) negative.
- 2.9 ACCESSORY HARDWARE
 - A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments, and length to suit duct insulation thickness.
 - B. Splitter Damper Accessories: Zinc-plated damper blade bracket; 1/4-inch (6-mm), zinc-plated operating rod; and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.
 - C. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a wormgear action, in sizes 3 to 18 inches (75 to 450 mm) to suit duct size.
 - D. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

- 3.1 INSTALLATION
 - A. Install duct accessories according to applicable details shown in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and NAIMA's "Fibrous Glass Duct Construction Standards" for fibrous-glass ducts.
 - B. Install volume dampers in lined duct; avoid damage to and erosion of duct liner.
 - C. Provide test holes at fan inlet and outlet and elsewhere as indicated.
 - D. Install fire and smoke dampers according to manufacturer's UL-approved written instructions.1. Install fusible links in fire dampers.
 - E. Install duct access panels for access to both sides of duct coils. Install duct access panels downstream from volume dampers, fire dampers, turning vanes, and equipment.
 - 1. Install duct access panels to allow access to interior of ducts for cleaning, inspecting, adjusting, and maintaining accessories and terminal units.
 - 2. Install access panels on side of duct where adequate clearance is available.
 - F. Label access doors according to Division "Mechanical Identification."

3.2 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust fire dampers for proper action.
- C. Final positioning of manual-volume dampers is specified in Section "Testing, Adjusting, and Balancing."

SECTION 23 33 46

FLEXIBLE DUCTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Furnish and install supply air branch duct runouts to diffusers as described in Contract Documents.

1.2 REFERENCES

- A. Reference Standards:
 - 1. National Fire Protection Association / American National Standards Institute:
 - a. NFPA 90A: 'Standard for the Installation of Air-Conditioning and Ventilating Systems' (2012 Edition).
 - 2. Underwriters Laboratories:
 - a. UL 181, 'Factory-Made Ducts and Air Connectors' (10th Edition).
 - b. UL 181B, 'Closure Systems for Use With Flexible Air Ducts and Air Connectors' (3rd Edition).

PART 2 - PRODUCTS

- 2.1 SYSTEM
 - A. Manufacturers:
 - 1. Manufacturer Contact List:
 - a. Anco Products Inc,
 - b. Thermaflex by Flexible Technologies
 - c. Flexmaster USA Inc, Houston, TX
 - B. Materials:
 - 1. Ducts:
 - a. Formable, flexible, circular duct which shall retain its cross-section, shape, rigidity, and shall not restrict airflow after bending.
 - b. Insulation:
 - 1) Nominal 1-1/2 inches (38 mm), 3/4 lb per cu ft (12 kg per cu m) density fiberglass insulation with air-tight, polyethylene or polyester core, sheathed in seamless vapor barrier jacket factory installed over flexible assembly.

- c. Assembly, including insulation and vapor barrier, shall meet Class I requirement of NFPA 90A and be UL 181 rated, with flame spread of 25 or less and smoke developed rating of 50 or under.
- d. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
 - 1) ANCO-FLEX 4625 by Anco Products.
 - 2) M-KC by Thermaflex by Flexible Technologies.
 - 3) Type 4m Insulated by Flexmaster.
- 2. Cinch Bands: Nylon, 3/8 inch removable and reusable type.

PART 3 - EXECUTION

- 3.1 INSTALLATION
 - A. Install duct in fully extended condition free of sags and kinks, using 60 inch maximum lengths.

B. Make duct connections by coating exterior of duct collar for 3 inches with duct sealer and securing duct in place over sheet metal collar with specified cinch bands.

SECTION 23 34 16

CENTRIFUGAL HVAC FANS

PART 1 - GENERAL

- 1.1 SUMMARY
 - A. This Section includes centrifugal fans and vent sets.
- 1.2 PERFORMANCE REQUIREMENTS
 - A. Project Altitude: Base air ratings on actual site elevations.
 - B. Operating Limits: Classify according to AMCA standards.
- 1.3 SUBMITTALS
 - A. Product Data: Include rated capacities, furnished specialties, and accessories for each unit scheduled and include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material gages and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
 - B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
 - C. Maintenance Data: For centrifugal fans to include in maintenance manuals specified in specifications.
- 1.4 QUALITY ASSURANCE
 - A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
 - C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- 1.5 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.
 - B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.
 - C. Lift and support units with manufacturer's designated lifting or supporting points.

1.6 COORDINATION

- A. Coordinate size and location of structural support members and/or shaft locations.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in these documents.
- 1.7 EXTRA MATERIALS
 - A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Belts: One set for each belt-driven unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cook, Loren Company.
 - 2. Greenheck.

2.2 HOUSINGS

- A. Roof Mounted Centrifugal Exhaust Fan.
 - The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 16 gauge marine alloy aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. The discharge baffle shall have a rolled bead for added strength. An integral conduit chase shall be provided through the curb cap and into the motor compartment to facilitate wiring connections. Bearings and drives shall be mounted on a minimum 14 gauge steel power assembly, isolated from the unit structure with rubber vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- 2.3 WHEELS
 - A. Roof Mounted Centrifugal Exhaust Fan
 - Wheel shall be centrifugal backward inclined, constructed of 100% aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.
- 2.4 SHAFTS
 - A. Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
 - B. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
 - C. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

2.5 BEARINGS

- A. Prelubricated and Sealed Shaft Bearings: Self-aligning, pillow-block-type ball bearings.
 - 1. Ball-Bearing Rating Life: ABMA 9, L_{50} of 200,000 hours.
 - 2. Roller-Bearing Rating Life: ABMA 11, L₅₀ of 200,000 hours.
- 2.6 BELT DRIVES
 - A. Description: Factory mounted, with final alignment and belt adjustment made after installation.1. Service Factor Based on Fan Motor: 1.5.
 - B. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
 - C. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with motors larger than 5 hp. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
 - D. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
 - E. Motor Mount: Adjustable for belt tensioning.
- 2.7 ACCESSORIES

- A. Scroll Access Doors: Shaped to conform to scroll, with quick-opening latches and gaskets.
- B. Companion Flanges: Galvanized steel, for duct connections.
- C. Scroll Drain Connection: NPS 1 (DN 25) steel pipe coupling welded to low point of fan scroll.
- D. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
- E. Spark-Resistant Construction: AMCA 99 (where required).
- F. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
- G. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.

2.8 MOTORS

- A. Refer to Section "Motors" for general requirements for factory-installed motors.
- B. Motor Construction: NEMA MG 1, general purpose, continuous duty, high efficiency, Design B.
- C. Enclosure Type: [Open drip-proof] [Totally enclosed, fan cooled].
- 2.9 SOURCE QUALITY CONTROL
 - A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
 - B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

- 3.1 INSTALLATION
 - A. Install centrifugal fans level and plumb.
 - B. Install units with clearances for service and maintenance.
 - C. Label fans according to requirements specified in Section "Mechanical Identification."
- 3.2 CONNECTIONS
 - A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Duct Accessories."
 - B. Install ducts adjacent to fans to allow service and maintenance.
 - C. Ground equipment.
 - D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

- A. Equipment Startup Checks:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Verify lubrication for bearings and other moving parts.
- B. Starting Procedures:

- 1. Energize motor and adjust fan to indicated rpm.
- 2. Measure and record motor voltage and amperage.
- C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
- D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Shut unit down and reconnect automatic temperature-control operators.
- F. Refer to Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.
- G. Replace fan and motor pulleys as required to achieve design airflow.
- H. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.
- 3.4 ADJUSTING
 - A. Adjust damper linkages for proper damper operation.
 - B. Adjust belt tension.
 - C. Lubricate bearings.
- 3.5 CLEANING
 - A. On completion of installation, internally clean fans according to manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.
 - B. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.
- 3.6 DEMONSTRATION
 - A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.
 - 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
 - 2. Review data in maintenance manuals. Refer to specifications Section "Closeout Procedures."
 - 3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

SECTION 23 37 13

DIFFUSERS, REGISTERS AND GRILLES

PART 1 - GENERAL

- 1.1 SUMMARY
 - A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.
- 1.2 DEFINITIONS
 - A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.
 - B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.
 - C. Register: A combination grille and damper assembly over an air opening.

1.3 SUBMITTALS

- A. Product Data: For each model indicated, include the following:
 - 1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
 - 2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
 - 3. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size, and accessories furnished.
 - 4. Assembly Drawing: For each type of air outlet and inlet; indicate materials and methods of assembly of components.
- B. Coordination Drawings: Reflected ceiling plans and wall elevations drawn to scale to show locations and coordination of diffusers, registers, and grilles with other items installed in ceilings and walls.

1.4 QUALITY ASSURANCE

A. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems."

PART 2 - PRODUCTS

- 2.1 MANUFACTURED UNITS
 - A. Diffusers, registers, and grilles are scheduled on Drawings.
 - B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Titus.
 - 2. Price
- 2.2 SOURCE QUALITY CONTROL
 - A. Testing: Test performance according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. Coordinate device locations with ceiling grid, sprinklers, and lights. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connection to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.
- 3.4 CLEANING
 - A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

SECTION 23 73 12

DX AIR HANDLING UNITS, SINGLE ZONE VAV

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Packaged air handling units.
- B. Refrigeration components

1.02 RELATED SECTIONS

- A. Section Motors
- B. Section Vibration Isolation.
- C. Section Ductwork Insulation.
- D. Section Ductwork.
- E. Section Ductwork Accessories: Flexible duct connections.
- F. Section Controls and Instrumentation
- G. Section Equipment wiring systems.

1.03 **REFERENCES**

- A. ASHRAE 90.1 ENERGY STANDARD FOR BUILDINGS EXCEPT LOW RISE RESIDENTIAL BUILDINGS
- B. ANSI/AHRI 340/360 PERFORMANCE RATING OF COMMERCIAL IND INDUSTRIAL UNITARY AIR CONDITIONING AND HEAT PUMP EQUIPMEN AND CONDENSING UNITS GREATER THAN 65,000BTUh AND BELOW 250,000BTUh
- C. AHRI 340 Commercial and Industrial Unitary Heat-pump Equipment, (heat pumps above 135,000 Btuh).

1.04 QUALITY ASSURANCE

A. Air Handling Units: Product of manufacturer regularly engaged in production of components who issues complete catalog data on total product.

1.05 SUBMITTALS

- A. Submit unit performance data including: capacity, nominal and operating performance.
- B. Submit Mechanical Specifications for unit and accessories describing construction, components and options.
- C. Submit shop drawings indicating overall dimensions as well as installation, operation and service clearances. Indicate lift points and recommendations and center of gravity. Indicate unit shipping, installation and operating weights including dimensions.
- D. Submit data on electrical requirements and connection points. Include recommeded wire and fuse sizes or MCA, sequence of operation, safety and start-up instructions.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- B. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.08 WARRANTY

A. Provide one year parts warranty.

PART 2 PRODUCTS

2.01 SUMMARY

- A. The contractor shall furnish and install air handling units(s) as shown as scheduled on the contract documents. The unit(s) shall be installed in accordance with this specification and perform at the specified conditions as scheduled.
- B. APPROVED MANUFACTURERS
 - 1. Trane:
 - 2. Carrier:
 - 3. Lennox:
 - 4. Substitutions: [prior approval required] as indicated under the general and/or supplemental conditions of these specifications.

2.02 GENERAL

A. Provide indoor-mounted, draw-thru, packaged air handling unit(s). Unit(s) shall be factoryassembled including direct-expansion evaporator coil, expansion valve(s), check valves, condensate drain pan, centrifugal fan assembly with fan motor(s) and mounting bracket sheaves, drives and belts, filters, and electrical controls. Units shall be suitable for either horizontal or vertical airflow configuration and be used with or without ductwork.

2.03 **CASING**

- A. Unit casing shall be constructed of zinc-coated, heavy gauge, galvanized steel. Exterior surfaces shall be cleaned and finished with a baked enamel finish.
- B. Unit casing shall be completely insulated with fire-retardant, permanent, foil-faced, odorless glass fiber material.

2.04 **FANS**

- A. Provide fan section with forward curved, double width, double inlet, centrifugal type fan.
- B. Provide self-aligning, grease lubricated, ball or roller bearings with permanent lubrication fittings.
- C. Factory mount motor on slide rails. Provide access to motor, drive, and bearings through removable casing panels.
- D. Provide shafts constructed of solid hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.
- E. Provide cast iron or steel variable and adjustable pitched sheaves, dynamically balanced, bored to fit shafts and keyed.

2.05 **COILS**

- A. Provide configured aluminum fin surface mechanically bonded to copper tubing coil. Enclose coils with headers and return bends fully contained within casing. Coil shall have factory installed expansion valves and factory pressure and leak tested at 375 psig.
- B. Provide double sloped condensate drain pan constructed of PVC with external connections on either side of unit. The drain pan shall be removable for cleaning.

2.06 **MOTORS**

A. For additional static requirements, Odyssey Split Systems offer standard belt drive motors to meet and exceed a wide range of airflow needs.

2.07 FILTERS

A. Provide one inch throwaway filters, factory installed. Provide access from side panel for removal. Filter rack shall be field convertible to two inch capability with field provided two inch

throwaway filters.

2.08 CONTROLS

- A. Provide factory installed and wired controls including fan contactor, low voltage terminal strip and single point power entry.
- B. Provide factory installed FROSTAT to prevent coil freezing at low evaporator temperatures.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install unit on vibration isolators.

SECTION 26 00 00

ELECTRICAL

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. The following Summary of Work is intended as an aid to achieve an understanding of the various elements of work included in the project, as is not intended to be all-inclusive. Detailed descriptions of work and requirements are given in drawings and specifications.
- B. General Scope of Work:
 - 1. Providing new panels, feeders, conduits, disconnect, fire alarm, rough-in for telephone and data system, and new light fixtures.
- 1.4 COORDINATION
 - A. All electrical work shall be done under sub-contract to a General Contractor. Electrical Contractor shall coordinate all work through General Contractor, even in areas where only electrical work is to take place.
 - B. Work shall take place with minimal disruption to Owner's operations in areas surrounding the new building.
 - C. Cooperate fully with other contractors so that work under those contracts may be carried out smoothly, without interfering with or delaying work under this Contract.
- D. Fully coordinate with mechanical contractor for providing power to mechanical equipment.

1.5 UTILITIES

- 1. Coordinate with power company and provide conduit, and trenching from transformer to power source. Coordinate with water, telephone, cable and gas utilities to locate all utilities prior to digging in any area.
- 2. Obtain any approvals required from utilities to relocate utilities.
 - 3. Cost of relocating or bypassing utilities indicated on drawings shall be included in Base Bid.

1.6 CONTRACTOR USE OF PREMISES

- A. Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.
 - 1. Driveways and Entrances: Keep driveways and entrances serving the premises, clear and available to the Owner, the Owner's employees, and emergency vehicles at all time. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- B. Site Safety: Take every precaution to ensure the site does not present a threat to the safety of occupants and/or workers. Minimal safety requirements include, but are not limited to the following:
 - 1. Temporary fencing around construction areas.
 - 2. Yellow caution tape and construction barricades along open trenches during the day. Trenches shall be

covered at night and warning lights provided on construction barricades.

3. Temporary fencing around equipment while site work is in progress.

1.7 SUBMITTALS

1. To extradite the submittal process more efficiently, do not piece-meal the submittals. Submit entire electrical in a bound enclosure. This will eliminate delays in the submittal process. Unbound submittals shall be returned without review. Submit 10 copies minimum.

SECTION 26 00 01 ELECTRICAL GENERAL REQUIREMENTS

PART1- GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions, Specification Sections and all relevant documents shall form a part of this Section of the Specifications, and shall be incorporated in this Section and each Section 260000 hereinafter as if repeated verbatim herein. All conditions imposed by these documents shall be applicable to all portions of the work under this Section. Certain specific paragraphs of said references may be referred to hereinafter in this Section. These references are intended to point out specific items to the Contractor, but in no way relieve him of the responsibility of reading and complying with all relevant parts of the entire Specification.
- B. The Contractor shall examine and coordinate with all Contract Drawings and Specifications, and all Addenda issued. Failure to comply shall not relieve him of responsibility. The omission of details of other portions of the work from this Section shall not be used as a basis for a request for additional compensation.
- C. The specific features and details for other portions of the work related to the construction in progress or to the adjacent building shall be determined by examination at the site.

1.2 SCOPE OF WORK

- A. The requirements contained in this Section apply to all work performed under these Specifications.
- B. The work covered by this Section of the Specifications comprises the furnishing of labor, material, equipment, transportation, tools and services, and performing operations required for, and reasonably incidental to, the installation of the work in accordance with the applicable Contract Documents, and subject to the terms and conditions of the Contract.
- C. Refer to other Sections of the Specifications for related work.

1.3 DEFINITION OF "CONTRACTOR"

- A. Where the word "Contractor" is used under any Section of this Section of the Specifications, it shall mean the Contractor engaged to execute the work included under that Section, even though this Contractor may be technically described as a Subcontractor, or an authorized representative.
- B. If the Contractor, engaged to execute a portion of the work, employs a Subcontractor to perform some of that work, he shall be completely responsible for the proper execution of this Subcontractor's work, in full conformity with the Contract Documents.

1.4 RESPONSIBILITY OF THE CONTRACTOR

- A. The Contractor shall be responsible for all work of every description in connection with this Section of the Specifications. The Contractor shall specifically and distinctly assume, and does zeso assume, all risk for damage or injury from whatever cause to property or person used or employed on or in connection with this work and of all damages or injury to any person or property wherever located, resulting from an action or operation under the Contract in connection with the work, and undertake the responsibility to defend the Owner against all claims on account of any such damage or injury.
- B. The Contractor will be held responsible for the satisfactory execution and completion of the work in accordance with the true intent of the Contract Documents. The Contractor shall provide without extra charge all incidental items required as part of the work, even though it may not be specifically indicated. If the Contractor has reason for objecting to the use of any material, equipment, device or method of construction as indicated, the Contractor shall make report of such objections to the Owner's

Representative, obtain proper approval and adjustment to the Contract, and shall proceed with the work.

1.5 TERMINOLOGY

- A. Whenever the words "furnish", "provide", "furnish and install", "provide and install", and similar phrases occur, it is the intent that the materials, equipment and devices described be furnished, installed and connected under this Section, complete for operation, unless specifically noted to the contrary.
- B. It is also the intent, unless specifically noted to the contrary, that all materials, equipment and devices described and specified under this Section of the Specifications be similarly furnished, installed and connected under this Section, whether or not a phrase as described in the preceding paragraph has been actually included.
- C. Whenever the words "Owner's Representative" occurs, it is intended to refer to the Architect, Engineer and/or specific Owner's Representative responsible for or capable of providing the necessary direction pertaining to the referenced issue.

1.6 ORDINANCES, PERMITS AND CODES

- A. It shall be the Contractor's duty to perform the work and provide the materials covered by these specifications in conformance with all ordinances and regulations of all authorities having jurisdiction.
- B. All work herein shall conform to all applicable laws, ordinances and regulations of the local utility companies.
- C. The Contractor shall obtain and pay for all permit and connection fees as required for the complete installation of the specified systems, equipment, devices and materials.
- D. The Contractor shall obtain permits, plan checks, inspections and approvals applicable to the work as required by the regulatory authorities. Fees and costs of any nature whatsoever incidental to these permits, inspections and approvals shall be assumed and paid by the Contractor. The pro-rata costs, if any, for utilities serving this property will be paid for by the Owner and shall not be included as part of this Contract.
- E. The work shall be in accordance with, but shall not be limited to, the requirements of:
 - 1 National Fire Protection Association
 - 2 National Electrical Code
 - 3 National Safety Code
 - 4 State of Texas Safety Code
 - 5 Local City Building Codes
 - 6 State of Texas Building Codes
- F. Codes and standards referred to are minimum standards. Where the requirements of the Drawings or Specifications exceed those of the codes and regulations, the Drawings and Specifications govern.

1.7 MATERIALS, EQUIPMENT AND DEVICE DESCRIPTION

- A. Materials, equipment and devices shall be of the best quality customarily applied in quality commercial practice, and shall be the products of reputable manufacturers. Each major component shall bear a nameplate giving the name and address of the manufacturer, and the catalog number or designation of the component.
- B. Materials, equipment and devices furnished under this Section of the Specifications shall be essentially the standard product of the specified manufacturer, or where allowed, an alternate manufacturer. Where two or more units of the same kind or class of a specific item are required, these shall be the products of a single manufacturer; however, the component parts of the item need not be the products of one manufacturer.
- C. In describing the various materials, equipment and devices, in general each item will be described

singularly, even though there may be a multiplicity of identical items. Also, where the description is only general in nature, exact sizes, duties, space arrangements, horsepower requirements and other data shall be determined by reference to the Contract Documents.

D. Space allocations for materials, equipment and devices have been made on the basis of present and known future requirements and the dimensions of items of equipment or devices of a particular manufacturer whether indicated or not. The Contractor shall verify that all materials, equipment and devices proposed for use on this project are within the constraints of the allocated space.

1.8 QUALITY ASSURANCE

- A. Materials, equipment and devices shall be new and of the quality specified, and shall be free from defects at the time of installation. Materials, equipment and devices damaged in shipment or otherwise damaged or found defective prior to acceptance by the Owner shall not be repaired at the job site, but shall be replaced with new materials, equipment or devices identical with those damaged, unless specifically approved otherwise by the Owner's Representative.
- B. Wherever a UL standard has been established for a particular type of material, equipment or device, each item of such material, equipment or device provided on this project shall meet the requirements of the UL standard in every way, and shall be UL listed and labeled.

1.9 REFERENCE STANDARDS

- A. Materials, equipment, devices and workmanship shall comply with applicable local, county, state and national codes, laws and ordinances, utility company regulations and industry standards.
- B. In case of differences between building codes, state laws, local ordinances, industry standards, utility company regulations and the Contract Documents, the most stringent shall govern. The Contractor shall promptly notify the Owner's Representative in writing of any such difference. Should the Contractor perform any work that does not comply with local codes, laws and ordinances, industry standards or other governing regulations, the work shall be corrected of noncompliance deficiencies with the Contractor bearing all costs.
- C. In addition to the aforementioned ordinances, industry standards published by the following organizations shall apply:

AABM	-	American Association of Battery Manufacturers
ADA	-	American's with Disabilities Act
AIA	-	American Institute of Architects
ANSI	-	American National Standards Institute
ASTM	-	American Society for Testing and Materials
CBM	-	Certified Ballast Manufacturers Association
ETL	-	Electrical Testing Laboratories
FM	-	Factory Mutual
ICEA	-	Insulated Cable Engineers Associated
IEEE	-	Institute of Electrical and Electronic Engineers
IES	-	Illuminating Engineering Society
IRI	-	Industrial Risk Insurance
NBS	-	National Bureau of Standards
NEC	-	National Electrical Code
NECA	-	National Electrical Contractors Association

NEMA	-	National Electrical Manufacturers Association
NESC	-	National Electrical Safety Code
NETA	-	National Electrical Testing Association
NFPA	-	National Fire Protection Association
UL	-	Underwriters Laboratories

1.10 DRAWINGS AND SPECIFICATIONS

- A. The interrelation of the Drawings (including the schedules) and the Specifications are as follows:
 - 1 The Drawings establish quantities, locations, dimensions and details of materials, equipment and devices. The schedules on the Drawings indicate the capacities, characteristics and components.
 - 2 The Specifications provide written requirements for the quality, standard and nature of the materials, equipment, devices and construction systems.
- B. The Drawings and Specifications shall be considered as being compatible; therefore, the work called for by one and not by the other shall be furnished and installed as though called for by both. Resolution of conflicts between Drawings and Specifications shall be as follows:
 - 1 If the Drawings and Specifications disagree in themselves, or with each other, the Contractor's pricing shall be based on furnishing and installing the most expensive combination of quality and quantity of work indicated for a complete operable system. Contractor is responsible to notifying the Architect and Engineer. In the event of this type of disagreement, the resolution shall be determined by the Owner's Representative. The contractor shall assume for an operable system at the most expensive combination as per the latest National Electrical Code. The contractor shall review all drawings and specifications prior to bid date.
 - 2 The Contractor shall be responsible for bringing any conflicts in the Drawings and the Specifications to the attention of the Owner's Representative immediately, prior to bid date.
 - 3 In general, if there is conflict between the Drawings and Specifications, the Drawings shall govern the Specifications.
 - 4 Where the Specifications do not fully agree with schedules on the Drawings, the schedules shall govern. Actual numerical dimensions indicated on the Drawings govern scale measurements and large scale details govern small scale drawings.
 - 5 Materials, equipment and devices called for on the Drawings and not indicated herein, shall be completely provided and installed as though it were fully described herein.
 - 6 Materials, equipment and devices called for herein shall be completely provided and installed, whether or not it is fully detailed, scheduled or indicated on the Drawings.
- C. The Contractor shall examine the Drawings and Specifications of the other portions of the work for fixtures and finishes in connection with this work. The Contractor shall carefully examine the Drawings to determine the general construction conditions, and shall familiarize himself with all limitations caused by such conditions.
- D. When discrepancies exist between scale and dimension, or between the Drawings of the various portions of the work, they shall be called to the attention of the Owner's Representative for further instruction, whose instructions shall be final and binding and work promptly resumed without any additional cost to the Owner.
- E. Review the construction details of the building(s) as illustrated on the Drawings of the other portions of the work, i.e., architectural, structural, civil, landscape, etc., and be guided thereby. Route conduits and set all boxes as required by the pace of the general construction.

- F. The Drawings diagrammatically show the sizes and locations of the various equipment and devices, and the sizes of the major interconnecting wires, without showing exact details as to elevations, offsets, control wiring and other installation requirements. Carefully layout the work at the site to conform to the architectural and structural conditions, to avoid obstructions and to permit proper grading of pipe associated with other portions of the work. In cooperation with other Contractors, determine the exact location of equipment and devices and connections thereto by reference to the submittals and rough-in drawings, and by measurements at the site. Make minor relocations necessitated by the conditions at the site, or directed by the Owner's Representative, without additional cost to the Owner.
- G. The Drawings and Specifications are intended to describe and illustrate systems which will not interfere with the structure of the building(s), fit into the available spaces, and insure complete and satisfactory operating installations. Prepare installation drawings as required for all critical areas illustrating the installation of the work in this Section as related to the work of all other Sections and correct all interferences with the other portions of the work or with the building structures before the work proceeds.
- H. The Drawings do not indicate the existing electrical installations other than to identify modifications or extensions thereto. Visit the site and ascertain the conditions to be met and the work to be accomplished in removing and modifying the existing work, and in installing the new work. Failure to comply with this shall not constitute grounds for any additional payment in connection with removing or modifying any part of the existing installation or installing any new or temporary work under this Section.

1.11 SUBMITTALS

- A. Submit product data and shop drawings in accordance with the Specifications.
- B. Process product data and shop drawings to insure that the proposed materials, equipment and devices conform to the requirements of the Contract Documents, and that there are no omissions or duplications. Provide layouts, fabrication information and data for systems, materials, equipment and devices proposed for the project.
- C. Submittals shall be provided for review and approval on all systems, equipment, devices and materials proposed for use on this project. Submittals shall include, but not be limited to, the following:
 - 1 Lighting and Appliance Panelboards
 - 2 Disconnect Switches
 - 3 Circuit Breakers and Fuses
 - 4 Materials: conduit, conductors, connectors, supports, etc.
 - 5 Lighting Fixtures, Lamps and Control Systems/Devices
 - 6 Wiring Devices
 - 7 Transformers
 - 8 Distribution Panelboards
 - 9 Motor Control Center
 - 10 As indicated on each submittal section
- D. The product data shall not consist of manufacturer's catalogs or cut sheets that contain no indication of the exact item offered. The submission on individual items shall designate the exact item offered.
- E. Do not submit detailed quantitative listings of materials, equipment and devices. It is the Contractor's responsibility to provide proper sizes and quantities to conform to Contract Documents.
- F. Assemble submittals on related items procured from a single manufacturer in bound brochures or other suitable package form, rather than submitting a multiplicity of loose sheets.
- G. Prepare shop drawings whenever equipment proposed varies in physical size and arrangement from that indicated thus causing rearrangement of equipment space, where tight spaces require extreme coordination

between this work and other work, where called for elsewhere in these Specifications and where specifically requested by the Owner's Representative. Shop drawings shall be prepared at a scale of not less than 1/4 inch equals 1 foot.

H. The Contractor shall sign the submittal as an indication of compliance with the Contract Documents. If there are any deviations from the Contract Documents, he shall so indicate on the submittal. Any deviations not so indicated shall be cause for rejection and removal of the non-complying equipment at the Contractor's expense.

1.12 SUBSTITUTIONS

- A. Where a single manufacturer is mentioned by trade name or manufacturer's name, unless specifically noted otherwise, it is the only manufacturer that will be accepted.
- B. Where multiple manufacturers are listed, none other than those manufacturers will be accepted.
- C. Manufacturers not listed will be considered for substitution prior to bid only. The substitute manufacturer shall submit a complete copy of the appropriate technical specification section minimum seven (7) business days prior to bid with each sub-paragraph noted with the comment, "compliance", "deviation", "alternate" or "not applicable". In the case of non-primary, vendor-supplied items, the name of the sub-vendor supplying said item, including model number, shall be indicated.
 - 1 By noting the term "compliance" or "C", it shall be understood that the manufacturer is in full compliance with the item specified and will provide exactly the same with no deviations.
 - 2 By noting the term "deviation" or "D", it shall be understood that the manufacturer prefers to provide a different component in lieu of that specified. Manufacturer shall indicate all deviations.
 - 3 By noting the term "alternate" or "A", it shall be understood that the manufacturer proposes to provide the same operating function but prefers to do it in a different manner. An alternate shall be fully described as to what the manufacturer proposes to provide.
 - 4 By noting the term "not applicable" or "N/A", it shall be understood that the specified item is not applicable to the project.
- D. It shall be understood that space allocations have been made on the basis of present and known future requirements and the dimensions of items of equipment or devices of a particular manufacturer whether indicated or not. If any item of equipment or device is offered in substitution which differs substantially in dimension or configuration from that indicated on the Drawings or specifications, provide as part of the submittal 1/4 inch equals 1 foot scaled drawings showing that the substitute can be installed in the space available without interfering with other portions of the work or with access for operations and maintenance in the completed project.
- E. Where substitute equipment or devices requiring different arrangement or connections from that indicated is accepted by the Owner's Representative, install the equipment or devices to operate properly and in harmony with the intent of the Contract Documents, making all incidental changes in piping, ductwork or wiring resulting from the equipment or device selection without any additional cost to the Owner. The Contractor shall pay all additional costs incurred by other portions of the work in connection with the substituted equipment or device.
- F. The Owner's Representative reserves the right to call for samples of any item of material, equipment or device offered in substitution, together with a sample of the specific item when, in their opinion, the quality of the item and/or the appearance is involved, and it is deemed that an evaluation of the item may be better made by visual inspection.
- G. When any request for a substitution of material, equipment or device is submitted and rejected, the item named in the Contract Documents shall be furnished. Repetitive submittal of substitutions for the same item will not be considered.
1.13 INSTALLATION DRAWINGS

- A. Prepare installation drawings for coordinating the work of this Section with the work of other Sections, to illustrate its concealment in finished spaces, to avoid obstructions, and to demonstrate the adaptability of any item of material, equipment or device in the space upon which the Contract Documents are based.
- B. Use these drawings in the field for the actual installation of this work. Provide three (3) copies, not for approval, to the Owner's Representative for his information, review and record.

1.14 WORKMANSHIP AND INSTALLATION

- A. In no case shall the Contractor provide a class of material, equipment, device or workmanship less than that required by the Contract Documents or applicable codes, regulations, ordinances or standards. All modifications which may be required by a local authority having legal jurisdiction over all or any part of the work shall be made by the Contractor without any additional charge. In all cases where such authority requires deviations from the requirements of the Drawings or Specifications, the Contractor shall report same to the Owner's Representative and shall secure his approval before the work is started.
- B. The work shall be performed by properly licensed technicians skilled in their respective trades. All materials, equipment and devices shall be installed in accordance with the recommendations of the manufacturer and in the best standard practice to bring about results of a first class condition.
- C. The NECA "Standards of Installation" as published by the National Electrical Contractors Association shall be considered a part of these Specifications, except as specifically modified by other provisions contained in these Specifications.

1.15 INSPECTION OF SITE

- A. The accompanying drawings do not indicate existing installations other than to identify modifications of and extensions thereto. The Contractor shall visit the site, inspect the installations and ascertain the conditions to be met and the work to be performed. Failure to comply with this shall not constitute ground for any additional payments in connection with removing or modifying any part of the existing installations and/or installing any new work under this Section.
- B. Review construction details of the adjacent building presently under construction during the site inspection and include all work required to modify the existing installations and install new materials, comprising a part of the installation. Review all construction details of the new building as illustrated on the drawings and be guided thereby.

1.16 WARRANTY

- A. All materials, equipment, devices and workmanship shall be warranted for a period of one year from the date of acceptance by the Owner's Representative for beneficial use by the Owner, except that where specific equipment is noted to have extended warranties. The warranty shall be in accordance with AIA Document A201. The Contractor shall be responsible for the proper registration of these warranties so that the Owner can make all proper claims should future need develop.
- B. The Contractor shall furnish to the Owner's Representative for transmittal to the Owner, the name, address and telephone number of those persons responsible for service on systems and equipment covered by the warranty.

1.17 OPERATION PRIOR TO ACCEPTANCE

A. When any equipment is operable, and it is to the advantage of the Contractor to operate the equipment, the Contractor may do so provided that he properly supervises the operation, and retains full responsibility for the equipment operated. Regardless of whether or not the equipment has or has not been operated, the Contractor shall clean the equipment properly, make required adjustments and complete punch list items before final acceptance by the Owner.

1.18 INSTRUCTION OF OWNER'S PERSONNEL

- A. Provide the services of competent engineers and/or technicians acceptable to the Owner's Representative to instruct other representatives of the Owner in the complete and detailed operation of each item of equipment or device of all the various electrical systems. These instructions shall be provided for whatever periods may be necessary to accomplish the desired results. Upon completion of these instructions, the Contractor shall obtain a letter of release, acknowledged by the Owner or his authorized representative, stating the dates on which the various kinds of instruction were given, and the personnel to whom the instructions were given.
- B. The Contractor shall be fully responsible for proper maintenance of equipment and systems until the instructions have been given to the Owner's personnel and the letter of release acknowledged.
- C. In providing the instructions to the Owner's personnel, the written operating and maintenance manuals shall be followed in all instances, and the Owner's personnel shall be familiarized with such manuals. Operating and maintenance manuals used for instructions shall include wiring diagrams, manufacturer's operating and maintenance instructions, parts lists (with sources identified), and other data as appropriate for each system.

1.19 SCHEDULE AND SEQUENCE OF WORK

A. The Contractor shall meet and cooperate with the Owner and Owner's Representative to schedule and sequence this work so as to insure meeting scheduled completion dates and avoid delaying other portions of the work. Work requiring special sequencing shall be at no additional cost to the Owner and shall have no impact on the schedule.

1.20 INSTALLATION INSPECTIONS AND CERTIFICATIONS

- A. Obtain timely inspections of the installation by the regulatory authorities. Remedy any deficiencies to the satisfaction of the inspecting official.
- B. Upon final completion of the work, obtain certificates of acceptance from the regulatory authorities. Deliver the certificates to the Owner's Representative for transmission to the Owner.

1.21 EQUIPMENT INSTALLATION

- A. Install equipment and devices in a manner to permit access to all surfaces or components, requiring such access, without the need to disassemble other unrelated parts of the work.
- B. Equipment specified to be factory assembled and tested prior to shipment shall not be disassembled at the job site and reassembled at its final location. Apparatus not so specified may be disassembled and reassembled in the proper location.
- C. Furnish all scaffolding, rigging and hoisting required for the installation of all the work.

1.22 CONCRETE HOUSEKEEPING PADS

- A. Concrete housekeeping pads shall be provided for all floor mounted equipment, unless noted or required otherwise.
- B. All pads shall be not less than 3-1/2" high and extend a maximum 3" beyond the actual equipment size. Coordinate the proper size of the pad with the equipment furnished. Pads shall be poured in forms built of new dressed lumber with corners chamfered using sheet metal or triangular wood strips nailed to the form. Use 6 x 6 No. 3 mesh for reinforcing. Install heavy duty adjustable anchor bolts, set in the form and positioned using templates, prior to pouring concrete. After the equipment is set on the pad, the equipment shall be aligned, leveled and fully grouted to the pad and all void spaces shall be filled with a non-shrinking grout.
- C. Perform all concrete work specified to be provided under this Section in strict accordance with the applicable provisions of Section, CONCRETE.

1.23 SLEEVES

- A. Each conduit, regardless of material, which passes through a concrete slab, masonry wall, or roof or portion of the building structure shall be free from the structure and shall pass through a sleeve.
- B. All sleeves shall be constructed from electrical-metallic tubing or equivalent weight galvanized steel tubing and shall be flush on both sides of the surface penetrated, unless noted otherwise. All sleeves penetrating the roof areas shall extend a minimum 10 inches above the roof with approved weatherproof counterflashing attached to the conduit above the roof. All sleeves penetrating floors shall extend a minimum of 6 inches above the finished floors. The sleeves shall be sized to allow free passage of the conduit to be inserted.
- C. Sleeves passing through walls or floors on or below grade or in moist areas shall be constructed of galvanized rigid steel and shall be designed with a suitable flange in the center to form a waterproof passage. After the conduit has been installed in the sleeves, the void space around the conduit shall be caulked and filled with an asphalt-base compound to insure a waterproof penetration. Jute twine caulking shall not be used due to susceptibility to termite infestation.

1.24 ESCUTCHEONS

- A. In each finished space, provided a chromium plated, sectional escutcheon on each conduit, or hanger rod penetrating a wall, floor or ceiling.
- B. Size escutcheons and collars to fit snugly around conduit and rods.
- C. Where required, provide escutcheons with set screws so that they fit snugly against the finished surface.

1.25 ACCESS PANELS

- A. Provide wall and ceiling access panels for unrestricted access to all concealed electrical equipment items and devices installed behind furrings, chases or non-removable suspended ceilings.
- B. Access panels shall be UL listed and labeled as required to suit the fire rating of the surface in which installed, with mounting straps, concealed hinges, screwdriver locks, 180 degree open door design, 16 gauge steel construction and door and frame finished in prime coat finish. Panels shall be 12-inch by 12-inch minimum size, but shall be larger as the access requirement of the concealed electrical equipment item or device increases.

1.26 SEALING OF PENETRATIONS

- A. All penetrations in horizontal or vertical fire-rated construction shall be sealed using approved fire-rated sealing materials equivalent to the following:
 - 1 Foam: Dow Corning 3-6548 RTV silicone foam, liquid component Part 4 (black) and liquid component Part B (off-white).
 - 2 Sealant: Dow Corning 96-081 RTV silicone adhesive sealant.
 - 3 Damming Materials: Mineral fiberboard, mineral fiber matting, mineral fiber putty, plywood or particle board, as selected by applicator.
- B. Preparation: Remove combustible materials and loose impediments from penetration opening and involved surfaces. Remove free liquid and oil from penetration surfaces.
- C. Installation: In accordance with manufacturer's instructions, install damming materials and sealant to cover and seal penetration openings; inject foam mixtures into openings.
- D. In addition to the Dow Corning products, equal products by Spec Seal Firestop Products, 3M Fire Barrier or CS240 Firestop are acceptable.

1.27 PROTECTION OF APPARATUS

A. At all times take every precaution to properly protect apparatus from damage due to dust, dirt, water, etc. or from damage due to physical forces. Include the erection of temporary shelters as required, to adequately protect any apparatus stored at the site, the cribbing of any apparatus directly above the

construction, and the covering of apparatus in the incomplete building with tarpaulins or other protective covering. Failure on the part of the Contractor to comply with the above to the entire satisfaction of the Owner's Representative will be sufficient cause for the rejection of the pieces of apparatus in question.

- B. Responsibility for the protection of apparatus extend also to existing apparatus involved in this Section of the work, whether such apparatus is designated to be used temporarily and later removed, or is to be reused as a part of the permanent installation. Erect temporary sheltering structures, provide temporary bracing and supports, or cover equipment as required or directed to afford proper protection for that equipment.
- C. The Contractor shall protect this work and the work of all other Contractors from damage by his work or workmen and shall make good any damage thus caused. He shall also be responsible for the proper protection of his equipment, machinery, materials and accessories delivered and installed on the job.

1.28 INSTALLATION OF CONTROL AND OPERATING DEVICES

- A. The highest operable part of controls (light switches, dimmer switches, emergency power off devices, etc.), receptacles (electrical and communications) and other operable devices shall be 48" above finish floor. The lowest operable part shall be no less than 15" above finished floor. For purposes of uniformity, unless noted otherwise, the top of a device shall be maximum 48" AFF and the bottom of a device shall be minimum 15" AFF. Refer to the electrical symbols list on the Drawings for specific requirements.
- B. Visual alarm appliances shall be placed 80" above finished floor (the highest floor level within a space) or 6" below the ceiling, whichever is lower.

1.29 INSTALLATION AND CONNECTION OF OTHER SECTION'S EQUIPMENT

A. Verify the electrical requirements of all equipment furnished under other Sections, separate contracts, or by the Owner. Install conduit, power wiring, control wiring, devices, etc. as required for complete operation of all equipment.

1.30 OPTION TO RELOCATE OUTLETS AND RELATED DEVICES

A. The location of power, data and telephone outlets, wall switches and other related devices

may be relocated at the Owner's option, at no

additional cost to the Owner, to a point within10 feet of their present location provided the Contractor is notified prior to installation.

1.31 COOPERATION AND CLEAN-UP

- A. It shall be the responsibility of the Contractor to cooperate fully to keep the job site in a clean and safe condition. Upon the Contractor shall immediately remove all of his tools, equipment, surplus materials and debris.
- B. After he installation is complete and before the equipment is energized, clean the interior and exterior of all equipment thouroughly. Clean equipment, removing all debris, rubbish and foreign materials. Each component shall be cleaned and all dust and other foreign material. Components shall be cleaned of oxidation. The inside and outside of all switchgear shall also be wiped clean with lemon-oil rag after all other cleaning is complete. Any portion of the work requiring touch-up finishing shall be so finished to equal the specified finish on the product.

1.32 RECORD DRAWINGS AND DOCUMENTATION FOR OWNER

A. The Contractor shall obtain at his own expense a complete set of blueline prints on which to keep an accurate record of the installation of all materials, equipment and devices covered by the Contract. The Contractor shall record up to date information at least once a week and retain the set of prints on site for periodic review by the Architect/Engineer. The record drawings shall indicate the location of all equipment and devices, and the routing of all systems. If the Contractor prepared large scale installation drawings of electrical rooms, conduit routing, busduct, routing, etc., these drawings or reproducible sepias

therefrom shall be revised as required to accurately illustrate the actual installation. All conduit buried in concrete slabs, walls and below grade shall be located by dimension; both horizontally and by vertical elevation, unless a surface mounted device in each space indicates the exact location.

- B. Upon anticipated completion of the job, obtain one complete reproducible set of the original drawings on which to neatly, legibly and accurately transfer all project related notations and deliver these record drawings to the Architect/Engineer at job completion before final payment and delivery to the Owner. This information shall be delivered prior to final acceptance.
- C. The Contractor shall accumulate in duplicate during the job progress, the following data prepared in indexed 3-ring looseleaf, hard-back binders sized for 8-1/2 inch by 11 inch sheets. No binder shall exceed 3-1/2 inches thick. This data shall be turned over to the Owner's Representative for review and subsequent delivery to the Owner prior to final acceptance.
 - 1 Warranties, guarantees and manufacturer's directions on material, equipment and devices covered by the Contract.
 - 2 Approved lighting fixture brochures, wiring diagrams and control diagrams.
 - 3 Copies of approved submittals and shop drawings.
 - 4 Operating instructions and recommended maintenance procedures for major apparatus.
 - 5 Copies of all other data and/or drawings required during construction.
 - 6 Repair parts list of major apparatus, including name, address and telephone number of local supplier or representative.
 - 7 Tag charts and diagrams hereinbefore specified.
- 1.33 FINAL OBSERVATION
 - A. The purpose of the final observation is to determine whether the Contractor has completed the construction in accordance with the Contract Documents and that in the Owner Representative's opinion the installation is satisfactory for final acceptance by the Owner.
 - B. It shall be the responsibility of the Contractor to assure that the installation is ready for final acceptance prior to calling upon the Owner's Representative to make a final observation.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- 1.2 SUMMARY
 - A. This Section includes the following:
 - 1. Raceways.
 - 2. Building wire and connectors.
 - 3. Supporting devices for electrical components.
 - 4. Electrical identification.
 - 5. Electricity-metering components.
 - 6. Concrete equipment bases.
 - 7. Electrical demolition.
 - 8. Cutting and patching for electrical construction.
 - 9. Touchup painting.
- 1.3 DEFINITIONS
 - A. EMT: Electrical metallic tubing.
 - B. FMC: Flexible metal conduit.
 - C. IMC: Intermediate metal conduit.
 - D. LFMC: Liquidtight flexible metal conduit.
 - E. RNC: Rigid nonmetallic conduit.
- 1.4 SUBMITTALS
 - A. Product Data: For electricity-metering equipment.
 - B. Shop Drawings: Dimensioned plans and sections or elevation layouts of electricity-metering equipment.
 - C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
 - 1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
- B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.
- C. Coordinate electrical service connections to components furnished by utility companies.
 - 1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.

- 2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.
- D. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces. Access doors and panels are specified in Architectural documents.
- E. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.
- F. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

PART 2 - PRODUCTS

2.1 SUPPORTING DEVICES

- A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.
- B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.
- C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch- (14-mm-) diameter slotted holes at a maximum of 2 inches (50 mm) o.c., in webs.
- D. Slotted-Steel Channel Supports: Comply with Division Section "Metal Fabrications" for slotted channel framing.
 - 1. Channel Thickness: Selected to suit structural loading.
 - 2. Fittings and Accessories: Products of the same manufacturer as channel supports.
- E. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.
- F. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
- G. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.
- H. Expansion Anchors: Carbon-steel wedge or sleeve type.
- I. Toggle Bolts: All-steel springhead type.
- J. Powder-Driven Threaded Studs: Heat-treated steel.

2.2 ELECTRICAL IDENTIFICATION

- A. Identification Devices: A single type of identification product for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.
- B. Raceway and Cable Labels: Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway and cable size.
 - 1. Type: Pretensioned, wraparound plastic sleeves. Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the item it identifies.
 - 2. Type: Preprinted, flexible, self-adhesive, vinyl. Legend is overlaminated with a clear, weather- and chemical-resistant coating.
 - 3. Color: Black letters on orange background.
 - 4. Legend: Indicates voltage.
- C. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape, not less than 1 inch wide by 3 mils thick (25 mm wide by 0.08 mm thick).
- D. Underground Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape with the following features:
 - 1. Not less than 6 inches wide by 4 mils thick (150 mm wide by 0.102 mm thick).
 - 2. Compounded for permanent direct-burial service.
 - 3. Embedded continuous metallic strip or core.
 - 4. Printed legend that indicates type of underground line.
- E. Tape Markers for Wire: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.
- F. Color-Coding Cable Ties: Type 6/6 nylon, self-locking type. Colors to suit coding scheme.

- G. Engraved-Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch (1.6-mm) minimum thickness for signs up to 20 sq. in. (129 sq. cm) and 1/8-inch (3.2-mm) minimum thickness for larger sizes. Engraved legend in black letters on white background.
- H. Interior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Preprinted, aluminum, baked-enamel-finish signs, punched or drilled for mechanical fasteners, with colors, legend, and size appropriate to the application.
- I. Exterior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm), galvanized-steel backing, with colors, legend, and size appropriate to the application. 1/4-inch (6-mm) grommets in corners for mounting.
- J. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

2.3 EQUIPMENT FOR UTILITY COMPANY'S ELECTRICITY METERING

- A. Current-Transformer Cabinets: Comply with requirements of electrical power utility company.
- B. Meter Sockets: Comply with requirements of electrical power utility company.
- C. Modular Meter Centers: Factory-coordinated assembly of a main meter center circuit-breaker unit with wireways, tenant meter socket modules, and tenant branch circuit breakers arranged in adjacent vertical sections, complete with interconnecting buses.
 - 1. Housing: NEMA 250, Type 3R enclosure.
 - 2. Tenant Branch Circuit Breakers: Series combination rated to protect circuit breakers in downstream panelboards that have 10,000-A interrupting capacity, minimum.

2.4 CONCRETE BASES

- A. Concrete Forms and Reinforcement Materials: As specified in Division Section "Cast-in-Place Concrete."
- B. Concrete: 3000-psi (20.7-MPa), 28-day compressive strength as specified in Division Section "Cast-in-Place Concrete."

2.5 TOUCHUP PAINT

- A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.
- B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION

- 3.1 ELECTRICAL EQUIPMENT INSTALLATION
 - A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.
 - B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
 - C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
 - D. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 RACEWAY AND CABLE INSTALLATION

- A. Conceal raceways and cables, unless otherwise indicated, within finished walls, ceilings, and floors.
- B. Install raceways and cables at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Locate horizontal raceway runs above water and steam piping.
- C. Use temporary raceway caps to prevent foreign matter from entering.
- D. Make conduit bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.
- E. Use raceway and cable fittings compatible with raceways and cables and suitable for use and location.
- F. Install raceways embedded in slabs in middle third of slab thickness where practical, and leave at least 1-inch (25-mm) concrete cover.
 - 1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.

- 2. Space raceways laterally to prevent voids in concrete.
- 3. Install conduit larger than 1-inch trade size (DN27) parallel to or at right angles to main reinforcement. Where conduit is at right angles to reinforcement, place conduit close to slab support.
- 4. Transition from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above floor.
- 5. Make bends in exposed parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for exposed parallel raceways.
- G. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of the pull wire.
- H. Install telephone and signal system raceways, 2-inch trade size (DN53) and smaller, in maximum lengths of 150 feet (45 m) and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements, in addition to requirements above.
- I. Connect motors and equipment subject to vibration, noise transmission, or movement with a maximum of 72-inch (1830-mm) flexible conduit. Install LFMC in wet or damp locations. Install separate ground conductor across flexible connections.
- J. Set floor boxes level and trim after installation to fit flush to finished floor surface.

3.3 ELECTRICAL SUPPORTING DEVICE APPLICATION

- A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.
- B. Dry Locations: Steel materials.
- C. Support Clamps for PVC Raceways: Click-type clamp system.
- D. Selection of Supports: Comply with manufacturer's written instructions.
- E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb (90-kg) design load.

3.4 SUPPORT INSTALLATION

- A. Install support devices to securely and permanently fasten and support electrical components.
- B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
- C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
- D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.
- E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
- F. Install 1/4-inch- (6-mm-) diameter or larger threaded steel hanger rods, unless otherwise indicated.
- G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleableiron hangers for 1-1/2-inch (38-mm) and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.
- H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.
- I. Simultaneously install vertical conductor supports with conductors.
- J. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches (610 mm) from the box.
- K. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.
- L. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

- M. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
 - 1. Wood: Fasten with wood screws or screw-type nails.
 - 2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
 - 3. New Concrete: Concrete inserts with machine screws and bolts.
 - 4. Existing Concrete: Expansion bolts.
 - 5. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete.
 - 6. Steel: Welded threaded studs or spring-tension clamps on steel.
 - a. Field Welding: Comply with AWS D1.1.
 - 7. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
 - 8. Light Steel: Sheet-metal screws.
 - 9. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.5 IDENTIFICATION MATERIALS AND DEVICES

- A. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.
- C. Self-Adhesive Identification Products: Clean surfaces before applying.
- D. Identify raceways and cables with color banding as follows:
 - 1. Bands: Pretensioned, snap-around, colored plastic sleeves or colored adhesive marking tape. Make each color band 2 inches (51 mm) wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
 - 2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (8-m) maximum intervals in congested areas.
 - 3. Colors: As follows:
 - a. Fire Alarm System: Red.
 - b. Security System: Blue and yellow.
 - c. Telecommunication System: Green and yellow.
- E. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding may be used for voltage and phase identification.
- F. Install continuous underground plastic markers during trench backfilling, for exterior underground power, control, signal, and communication lines located directly above power and communication lines. Locate 6 to 8 inches (150 to 200 mm) below finished grade. If width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches (400 mm), overall, use a single line marker.
- G. Color-code 208/120-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:
 - 1. Phase A: Black.
 - 2. Phase B: Red.
 - 3. Phase C: Blue.
 - 4. Neutral: White.
 - 5. Ground: Green.
- H. Color-code 480/277-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:
 - 1. Phase A: Brown.
 - 2. Phase B: Orange.

Edinburg Transit Terminal Interior Build-Out

- 3. Phase C: Yellow.
- 4. Neutral: White with a colored stripe or gray.
- 5. Ground: Green.
- I. Install warning, caution, and instruction signs where required to comply with 29 CFR, Chapter XVII, Part 1910.145, and where needed to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
- J. Install engraved-laminated emergency-operating signs with white letters on red background with minimum 3/8-inch-(9-mm-) high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

3.6 UTILITY COMPANY ELECTRICITY-METERING EQUIPMENT

A. Install equipment according to utility company's written requirements. Provide grounding and empty conduits as required by utility company.

3.7 FIRESTOPPING

A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly. Firestopping materials and installation requirements are specified in Division Section "Firestopping."

3.8 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

3.9 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.10 FIELD QUALITY CONTROL

- A. Inspect installed components for damage and faulty work, including the following:
 - 1. Raceways.
 - 2. Building wire and connectors.
 - 3. Supporting devices for electrical components.
 - 4. Electrical identification.
 - 5. Electricity-metering components.
 - 6. Concrete bases.
 - 7. Electrical demolition.
 - 8. Cutting and patching for electrical construction.
 - 9. Touchup painting.
- B. Test Owner's electricity-metering installation for proper operation, accuracy, and usability of output data.
 - 1. Connect a load of known kW rating, 1.5 kW minimum, to a circuit supplied by the metered feeder.
 - 2. Turn off circuits supplied by the metered feeder and secure them in the "off" condition.
 - 3. Run the test load continuously for eight hours, minimum, or longer to obtain a measurable meter indication. Use a test load placement and setting that ensure continuous, safe operation.
 - 4. Check and record meter reading at end of test period and compare with actual electricity used based on test load rating, duration of test, and sample measurements of supply voltage at the test load connection. Record test results.

Edinburg Transit Terminal Interior Build-Out

5. Repair or replace malfunctioning metering equipment or correct test setup; then retest. Repeat for each meter in installation until proper operation of entire system is verified.

3.11 REFINISHING AND TOUCHUP PAINTING

- A. Refinish and touch up paint. Paint materials and application requirements are specified in Division Section "Painting."
 - 1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
 - 2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
 - 3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.12 CLEANING AND PROTECTION

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

LOW-VOLTAGE ELECTRICAL POWER CONDUCTOR AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.3 SUBMITTALS

A. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.4 QUALITY ASSURANCE

- A. Listing and Labeling: Provide wires and cables specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
- B. Comply with NFPA 70.
- 1.5 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver wires and cables according to NEMA WC 26.
- 1.6 COORDINATION
 - A. Coordinate layout and installation of cables with other installations.
 - B. Revise locations and elevations from those indicated, as required to suit field conditions and as approved by Architect.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Wires and Cables:
 - a. American Insulated Wire Corp.; Leviton Manufacturing Co.
 - b. BICC Brand-Rex Company.
 - c. Carol Cable Co., Inc.
 - d. Senator Wire & Cable Company.
 - e. Southwire Company.
 - 2. Connectors for Wires and Cables:
 - a. AMP Incorporated.
 - b. General Signal; O-Z/Gedney Unit.
 - c. Monogram Co.; AFC.
 - d. Square D Co.; Anderson.

- e. 3M Company; Electrical Products Division.
- 2.2 BUILDING WIRES AND CABLES
 - A. UL-listed building wires and cables with conductor material, insulation type, cable construction, and rating as specified in Part 3 "Wire and Insulation Applications" Article.
 - B. Rubber Insulation Material: Comply with NEMA WC 3.
 - C. Thermoplastic Insulation Material: Comply with NEMA WC 5.
 - D. Ethylene Propylene Rubber Insulation Material: Comply with NEMA WC 8.
 - E. Conductor Material: Copper.
 - F. Stranding: Solid conductor for No. 10 AWG and smaller; stranded conductor for larger than No. 10 AWG.
 - G. Plenum rated cable for all cables above the ceiling.
- 2.3 CONNECTORS AND SPLICES
 - A. UL-listed, factory-fabricated wiring connectors of size, ampacity rating, material, type, and class for application and service indicated. Comply with Project's installation requirements and as specified in Part 3 "Wire and Insulation Applications" Article.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine raceways and building finishes to receive wires and cables for compliance with requirements for installation tolerances and other conditions affecting performance of wires and cables. Do not proceed with installation until unsatisfactory conditions have been corrected.
- 3.2 WIRE AND INSULATION APPLICATIONS
 - A. Service Entrance: Type RHW or THWN, in raceway.
 - B. Feeders: Type 75C insulation THHN/THWN, in raceway.
 - C. Fire-Pump Feeder: Type MI, 3-conductor.
 - D. Branch Circuits: Type THHN/THWN, in raceway.
 - E. Fire Alarm Circuits: Type THHN/THWN, in raceway.
 - F. Class 1 Control Circuits: Type THHN/THWN, in raceway.
 - G. Class 2 Control Circuits: Type THHN/THWN, in raceway.
 - H. Equipment or any device rated 100 amperes or less, conductor shall be rated 60C as per National Electrical Code.
 - I. Equipment or any device rated over 100 amperes, conductor shall be rated 75C as per National Electrical Code.
- 3.3 INSTALLATION
 - A. Install wires and cables as indicated, according to manufacturer's written instructions and NECA's "Standard of Installation."
 - B. Remove existing wires from raceway before pulling in new wires and cables.
 - C. Pull Conductors: Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
 - D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
 - E. Install exposed cables, parallel and perpendicular to surfaces of exposed structural members, and follow

surface contours where possible.

- F. Support cables according to Section "Basic Electrical Materials and Methods."
- G. Seal around cables penetrating fire-rated elements according to Section "Firestopping."
- H. Identify wires and cables according to Section "Basic Electrical Materials and Methods."
- I. Identify wires and cables according to Section "Electrical Identification."

3.4 CONNECTIONS

- A. Conductor Splices: Keep to minimum.
- B. Install splices and tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
- C. Use splice and tap connectors compatible with conductor material.
- D. Use oxide inhibitor in each splice and tap connector for aluminum conductors.
- E. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.
- F. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer.
- G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

- A. Testing: On installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.
- B. Correct malfunctioning conductors and cables at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes grounding and bonding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.
 - B. Related Sections include the following:
 - 1. List below only products, construction, and equipment that the reader might expect to find in this Section but are specified elsewhere.
 - 2. Section "Underground Ducts and Utility Structures" for ground test wells.

1.3 SUBMITTALS

- A. Revise this Article to suit Project and office practice. Frequently, no product submittal is required for this Section.
- B. Product Data: For each type of product indicated.
- C. Retain paragraph above if Product Data are required for each product specified. Retain paragraph below if Product Data are required only for selected products.
- D. Product Data: For the following:
 - 1. Ground rods.
 - 2. Chemical rods.
 - 3. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- E. Field Test Reports: Submit written test reports to include the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.4 QUALITY ASSURANCE

- A. Retain paragraph and subparagraph below if Contractor or manufacturer selects testing agency. Delete if Contractor is allowed to perform ground-resistance testing.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 1. Comply with UL 467.
- C. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.
- D. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Retain above for nonproprietary or below for semiproprietary Specification. Refer to Division 1 Section "Materials and Equipment."
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. See Editing Instruction No.1 in the Evaluations for cautions about naming products and manufacturers.
 - 2. Grounding Conductors, Cables, Connectors, and Rods:
 - a. Apache Grounding/Erico Inc.
 - b. Boggs, Inc.
 - c. Chance/Hubbell.
 - d. Copperweld Corp.
 - e. Dossert Corp.
 - f. Erico Inc.; Electrical Products Group.
 - g. Framatome Connectors/Burndy Electrical.
 - h. Galvan Industries, Inc.
 - i. Hastings Fiber Glass Products, Inc.
 - j. Ideal Industries, Inc.
 - k. ILSCO.
 - l. Kearney/Cooper Power Systems.
 - m. Korns: C. C. Korns Co.; Division of Robroy Industries.
 - n. Lightning Master Corp.
 - o. Lyncole XIT Grounding.
 - p. O-Z/Gedney Co.; a business of the EGS Electrical Group.
 - q. Raco, Inc.; Division of Hubbell.
 - r. Robbins Lightning, Inc.
 - s. Salisbury: W. H. Salisbury & Co.
 - t. Superior Grounding Systems, Inc.
 - u. Thomas & Betts, Electrical.

2.2 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Section "Conductors and Cables."
- B. If only copper conductors are permitted in Division 16 Section "Conductors and Cables," delete paragraph below.
- C. Material: copper.
- D. Equipment Grounding Conductors: Insulated with green-colored insulation.
- E. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.
- F. Grounding Electrode Conductors: Stranded cable.
- G. Underground Conductors: stranded, unless otherwise indicated.
- H. Sizes and types below are typical. Adjust to suit Project conditions and requirements.

- I. Copper Bonding Conductors: As follows:
 - 1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch (6.4 mm) in diameter.
 - 2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
 - 3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches (42 mm) wide and 1/16 inch (1.5 mm) thick.
 - 4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches (42 mm) wide and 1/16 inch (1.5 mm) thick.
- J. Delete paragraph and subparagraphs below if use of aluminum conductors is not permitted.
- K. Ground Conductor and Conductor Protector for Wood Poles: As follows:
 - 1. No. 4 AWG minimum, soft-drawn copper conductor.
 - 2. Conductor Protector: Half-round PVC or wood molding. If wood, use pressure-treated fir, or cypress or cedar.
- L. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

2.3 CONNECTOR PRODUCTS

- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
- C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

2.4 GROUNDING ELECTRODES

- A. Copper-clad steel is most common. See Evaluations for discussion on where other materials might be more appropriate.
- B. Ground Rods: Copper-clad steel.
 - 1. Select paragraph above or paragraph and subparagraph below. Sectional types are used when rods longer than 10 feet (3 m) are installed.
 - 2. Size: 3/4 by 120 inches (19 by 3000 mm) in diameter.
- C. Chemical Electrodes: Copper tube, straight or L-shaped, filled with nonhazardous chemical salts, terminated with a 4/0 bare conductor. Provide backfill material recommended by manufacturer.
- D. Test Wells: Provide handholes as specified in Section "Underground Ducts and Utility Structures."

PART 3 - EXECUTION

3.1 APPLICATION

- A. Delete paragraph below if only copper conductors are specified in Division 16 Section "Conductors and Cables."
- B. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
- C. In raceways, use insulated equipment grounding conductors.
- D. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells.
- E. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.
- F. Ground Rod Clamps at Test Wells: Use bolted pressure clamps with at least two bolts.
- G. Delete paragraph and subparagraphs below if grounding bus is not required, or edit to suit Project.

- H. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Use insulated spacer; space 1 inch (25.4 mm) from wall and support from wall 6 inches (150 mm) above finished floor, unless otherwise indicated.
 - 2. At doors, route the bus up to the top of the door frame, across the top of the doorway, and down to the specified height above the floor.
- I. Edit below to suit Project.
- J. Underground Grounding Conductors: Use tinned copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches (600 mm) below grade or bury 12 inches (300 mm) above duct bank when installed as part of the duct bank.

3.2 EQUIPMENT GROUNDING CONDUCTORS

- A. NEC permits two basic types of equipment grounding conductors: metallic raceway or cable sheath as the conductor, or a separate equipment grounding conductor. The installation of an equipment grounding conductor provides an additional degree of safe operation when compared to relying on raceway as the conductor. Revise paragraphs and subparagraphs in this Article to suit Project.
- B. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- C. Install equipment grounding conductors in all feeders and circuits.
- D. Select paragraph above or paragraph and subparagraphs below.
- E. Install insulated equipment grounding conductor with circuit conductors for the following items, in addition to those required by NEC:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Armored and metal-clad cable runs.
- F. Busway Supply Circuits: Install insulated equipment grounding conductor from the grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
- G. Computer Outlet Circuits: Install insulated equipment grounding conductor in branch-circuit runs from computer-area power panels or power-distribution units.
- H. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- I. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate equipment grounding conductor. Isolate equipment grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- J. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

- K. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.
- L. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.
- M. Coordinate paragraph and subparagraphs below with Drawings and Specification Sections for systems referenced. Edit to suit Project.
- N. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 - 1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch (6.4-by-50-by-300-mm) grounding bus.
 - 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- O. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a grounding electrode in addition to installing a separate equipment grounding conductor with supply branch-circuit conductors.

3.3 INSTALLATION

- A. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.
 - 1. Drive ground rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.
 - 2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.
- B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- C. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
- D. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
- E. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.
- F. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.
- G. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.
- H. Install one test well for each service at the ground rod electrically closest to the service entrance. Set top of well flush with finished grade or floor.
- I. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, Paragraph 250-81(c), using a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4 AWG. If

concrete foundation is less than 20 feet (6 m) long, coil excess conductor within the base of the foundation. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to a grounding electrode external to concrete.

3.4 CONNECTIONS

- A. Coordinate paragraph and subparagraphs below with Drawings.
- B. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - 4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
 - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- C. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- D. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- E. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- F. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.
- G. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- H. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- I. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.5 FIELD QUALITY CONTROL

- A. Retain one of three paragraphs below.
- B. Testing: Perform the following field quality-control testing:
 - 1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
 - 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure

ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.

- 3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
 - a. NFPA 70 has minimum value of 25 ohms. See Evaluations for discussion on appropriate grounding resistance values. Values listed below are typical; adjust to suit Project conditions.
 - b. Equipment Rated 500 kVA and Less: 10 ohms.
 - c. Equipment Rated 500 to 1000 kVA: 5 ohms.
 - d. Equipment Rated More Than 1000 kVA: 3 ohms.
 - e. Substations and Pad-Mounted Switching Equipment: 5 ohms.
 - f. Manhole Grounds: 10 ohms.
- 4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

3.6 GRADING AND PLANTING

- A. Delete below if inappropriate or if surface restoration work is covered on Drawings or in Division 2 Sections. Coordinate with Drawings.
- B. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Section "Landscaping." Maintain restored surfaces. Restore disturbed paving as indicated.

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions and Specification sections, apply to work covered by this Section.
- B. Comply with this sections, as applicable. Refer to other sections for coordination of work.

1.2 SCOPE OF WORK

A. Provide labor, material, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of supporting devices, including related systems and accessories.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Unistrut Corp.
- B. B-Line Systems, Inc.
- C. Midland Ross-Kindorf

2.2 MATERIALS

A. Suspension Hangers

1. Suspension hangers for individual conduit runs shall be zinc plated formed steel type.

B. Vertical Supports

1. Malleable iron one hole pipe straps shall be used for vertical runs

- C. Clamps
 - 1. Beam clamps shall be used for bar joists and beams.
- D. Anti-Vibration Hangers
 - 1. Anti-vibration hangers shall be combination type having a double deflection neoprene element in series with a steel coil spring; double deflection of 0.30"; steel coil spring shall be selected from a 1" static deflection series with a minimum additional travel to solid of ½"; spring diameters shall be large enough to permit 15 degree angular misalignment of the rod connecting the hanger to the ceiling support without rubbing the hanger box.

2.3 LIGHT FIXTURE HANGERS

- A. Refer to Section 26 51 00
- B. Corrosive Areas: PVC; at factory apply a minimum of 10-mil-thick PVC coating, bonded to metal, inside and outside. Z

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Hangers
 - 1. Approved hangers and stiff leg supports shall be installed in quantity and size as required to carry the weight of raceway and contents and shall be arranged to prevent vibration transmission to the building and allow for raceway movement.

2. Hangers shall be supported by means of uncoated solid steel rods which are threaded to allow vertical adjustments. Lock nuts shall be provided in sufficient number and location to lock all rod adjustments permanently at the adjusted height. Two lock nuts shall be used unless the nut tightens against a threaded socket. Minimum rod diameters shall be as follows:

B. NOMINAL CONDUIT SIZE	ROD DIAMETER
1/2" through 2"	1/4"
2-1/2" through 3"	3/8"
4" and 5"	1/2"

- 1. Hanger spacing shall be as required for proper and adequate support raceway, but in no case shall be less than one hanger per 8'-0" of raceway length except that conduit less than 1" diameter shall be supported at least every 6'-0".
- 2. Where numerous conduits are run parallel to one another, they may be supported from a trapeze type hanger arrangement with strut bottom.
- 3. Anti-vibration type hangers shall be provided for equipment as required to minimize vibration and/or as directed by the Architect/Engineer.

Supports

- 4. Support of hangers shall be by means of sufficient quantities of individual after set steel expansion shields, or beam clamps attached to structural steel.
- 5. Stiff-legs shall be furnished and installed in cases where support from overhead structure is not possible.
- 6. Ceiling mounted lighting fixtures shall be supported from the building structure at two opposite corners. The Contractor shall provide fixture hangers to properly interface with the ceiling system.
- 7. Furnish and install complete any additional structural support steel, brackets, fasteners, etc., as required to adequately support all raceway and equipment.
- 8. Support of hangers from concrete slabs shall be by means of sufficient quantity of "U" brackets attached with after set expansion shields and bolts.
- 9. Support of hangers from concrete tees shall be by means of sufficient quantity of angle iron brackets attached with after set expansion shields and bolts.

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
 - 1. Edit lists below to suit Project.
 - 2. Raceways include the following:
 - a. RMC.
 - b. IMC.
 - c. PVC externally coated, rigid steel conduits.
 - d. PVC externally coated, IMC.
 - e. EMT.
 - f. FMC.
 - g. LFMC.
 - h. LFNC.
 - i. RNC.
 - j. ENT.
 - k. Wireways.
 - l. Surface raceways.
 - 3. Boxes, enclosures, and cabinets include the following:
 - a. Device boxes.
 - b. Floor boxes.
 - c. Outlet boxes.
 - d. Pull and junction boxes.
 - e. Cabinets and hinged-cover enclosures.
- B. Related Sections include the following:
 - List below only products and equipment for this Project that the reader might expect to find in this Section but are specified elsewhere. Verify that Section titles listed below are correct for this Project's Specifications because Section titles may have changed since this Section was updated.
 - 2. Section "Basic Electrical Materials and Methods" for raceways and box supports.
 - 3. Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. FMC: Flexible metal conduit.
- D. IMC: Intermediate metal conduit.
- E. LFMC: Liquidtight flexible metal conduit.

- F. LFNC: Liquidtight flexible nonmetallic conduit.
- G. RMC: Rigid metal conduit.
- H. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
 - B. Delete below except for custom enclosures.
 - C. Shop Drawings: Include layout drawings showing components and wiring for nonstandard boxes, enclosures, and cabinets.

1.5 QUALITY ASSURANCE

- A. Listing and Labeling: Provide raceways and boxes specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
- B. Comply with NECA's "Standard of Installation."
- C. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of raceways and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Retain above for nonproprietary or below for semiproprietary Specification. Refer to Division 1 Section "Materials and Equipment."
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Metal Conduit and Tubing:
 - a. Alflex Corp.
 - b. Anamet, Inc.; Anaconda Metal Hose.
 - c. Anixter Brothers, Inc.
 - d. Carol Cable Co., Inc.
 - e. Cole-Flex Corp.
 - f. Electri-Flex Co.
 - g. Flexcon, Inc.; Coleman Cable Systems, Inc.
 - h. Grinnell Co.; Allied Tube and Conduit Div.
 - i. Monogram Co.; AFC.
 - j. Spiraduct, Inc.
 - k. Triangle PWC, Inc.
 - l. Wheatland Tube Co.
 - 2. Nonmetallic Conduit and Tubing:
 - a. Anamet, Inc.; Anaconda Metal Hose.
 - b. Arnco Corp.
 - c. Breeze-Illinois, Inc.

- d. Cantex Industries; Harsco Corp.
- e. Certainteed Corp.; Pipe & Plastics Group.
- f. Cole-Flex Corp.
- g. Condux International; Electrical Products.
- h. Electri-Flex Co.
- i. George-Ingraham Corp.
- j. Hubbell, Inc.; Raco, Inc.
- k. Lamson & Sessions; Carlon Electrical Products.
- l. R&G Sloan Manufacturing Co., Inc.
- m. Spiraduct, Inc.
- n. Thomas & Betts Corp.
- 3. Conduit Bodies and Fittings:
 - a. American Electric; Construction Materials Group.
 - b. Crouse-Hinds; Div. of Cooper Industries.
 - c. Emerson Electric Co.; Appleton Electric Co.
 - d. Hubbell, Inc.; Killark Electric Manufacturing Co.
 - e. Lamson & Sessions; Carlon Electrical Products.
 - f. O-Z/Gedney; Unit of General Signal.
 - g. Scott Fetzer Co.; Adalet-PLM.
 - h. Spring City Electrical Manufacturing Co.
- 4. Metal Wireways:
 - a. Hoffman Engineering Co.
 - b. Keystone/Rees, Inc.
 - c. Square D Co.

2.2 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit: ANSI C80.1.
- B. Rigid Aluminum Conduit: ANSI C80.5.
- C. IMC: ANSI C80.6.
- D. EMT and Fittings: ANSI C80.3.
 - 1. Fittings: Set-screw type.
- E. Fittings: NEMA FB 1; compatible with conduit/tubing materials.
- 2.3 NONMETALLIC CONDUIT AND TUBING
 - A. RNC: NEMA TC 2, Schedule 40 or 80 PVC.
 - B. RNC Fittings: NEMA TC 3; match to conduit or conduit/tubing type and material.
 - C. LFNC: UL 1660.

2.4 METAL WIREWAYS

- A. Material: Sheet metal sized and shaped as indicated.
- B. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- C. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.
- D. Select 1 of 4 paragraphs below.
- E. Wireway Covers: Screw cover type flanged-and-gasketed type.

F. Finish: Manufacturer's standard enamel finish.

2.5 OUTLET AND DEVICE BOXES

- A. Sheet Metal Boxes: NEMA OS 1.
- B. Edit paragraph below. Aluminum is also available and suitable for use with steel raceways.
- C. Cast-Metal Boxes: NEMA FB 1, Type FD, cast box with gasketed cover.
- 2.6 PULL AND JUNCTION BOXES
 - A. Small Sheet Metal Boxes: NEMA OS 1.
 - B. Cast-Metal Boxes: NEMA FB 1, cast aluminum with gasketed cover.

2.7 ENCLOSURES AND CABINETS

- A. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.
- B. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage, and include accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of raceway installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 WIRING METHODS

- A. Use a comprehensive wiring method schedule on Drawings or use this Article to specify where various raceway types are to be installed. Edit examples below, adding or deleting materials and methods to suit Project. Coordinate with Division 16 Section "Wires and Cables." Do not duplicate information on Drawings, in NFPA 70, or in other Division 16 Sections. List exceptions to stated requirements. Check code to avoid specifying uses not permitted.
- B. Outdoors: Use the following wiring methods:
 - 1. Exposed: Rigid steel.
 - 2. Concealed: Rigid steel.
 - 3. Underground, Single Run: RNC.
 - 4. Underground, Grouped: RNC.
 - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 6. Boxes and Enclosures: NEMA 250, Type 3R.
- C. Indoors: Use the following wiring methods:
 - 1. Exposed: EMT.
 - 2. Concealed: EMT.
 - 3. Underground, Single Run: RNC.
 - 4. Underground, Grouped: RNC
 - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except in wet or damp locations, use LFMC.
 - 6. Damp or Wet Locations: Rigid steel conduit.
 - 7. Boxes and Enclosures: NEMA 250, Type 1, except as follows:

- a. Select 1 of 2 subparagraphs below and add other specific box and enclosure requirements to suit Project.
- b. Damp or Wet Locations: NEMA 250, Type 4, stainless steel.

3.3 INSTALLATION

- A. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.
- B. Select paragraph above or below.
- C. Minimum Raceway Size: 3/4-inch trade size (DN21).
- D. Conceal conduit and EMT, unless otherwise indicated, within finished walls, ceilings, and floors.
- E. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- F. Install raceways level and square and at proper elevations. Provide adequate headroom.
- G. Complete raceway installation before starting conductor installation.
- H. Support raceways as specified in Section "Basic Electrical Materials and Methods."
- I. Use temporary closures to prevent foreign matter from entering raceways.
- J. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab.
- K. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.
- L. Use raceway fittings compatible with raceways and suitable for use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings, unless otherwise indicated.
- M. Run concealed raceways, with a minimum of bends, in the shortest practical distance considering the type of building construction and obstructions, unless otherwise indicated.
- N. Raceways Embedded in Slabs (Must be indicated on drawings to be embedded. Please notify Engineer if required but not shown): Install in middle third of slab thickness where practical, and leave at least 1-inch (25-mm) concrete cover.
 - 1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
 - 2. Space raceways laterally to prevent voids in concrete.
 - 3. Run conduit larger than 1-inch trade size (DN27) parallel to or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 4. Transition from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above floor.
- **O.** Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.
 - 1. Run parallel or banked raceways together, on common supports where practical.
 - 2. Make bends in parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- P. Join raceways with fittings designed and approved for the purpose and make joints tight.
 - 1. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.
 - 2. Use insulating bushings to protect conductors.
- Q. Tighten set screws of threadless fittings with suitable tools.

- R. Terminations: Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against the box. Where terminations are not secure with 1 locknut, use 2 locknuts: 1 inside and 1 outside the box.
- S. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align raceways so the coupling is square to the box and tighten the chase nipple so no threads are exposed.
- T. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of the pull wire.
- U. Telephone and Signal System Raceways, 2-Inch Trade Size (DN53) and Smaller: In addition to the above requirements, install raceways in maximum lengths of 150 feet (45 m) and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.
- V. Delete paragraph below if not applicable.
- W. Install raceway sealing fittings according to manufacturer's written instructions. Locate fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
 - 1. Where conduits pass from warm to cold locations, such as the boundaries of refrigerated spaces.
 - 2. Where otherwise required by NFPA 70.
 - X. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches (150 mm) above the floor. Install screwdriver-operated, threaded flush plugs flush with floor for future equipment connections.
 - Y. Flexible Connections: Use maximum of 6 feet (1830 mm) of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquidtight flexible conduit in wet or damp locations. Install separate ground conductor across flexible connections.
 - Z. Delete paragraph below if no high-frequency installation.
 - AA.Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in a nonmetallic sleeve.
 - BB. Do not install aluminum conduits embedded in or in contact with concrete.
 - CC. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.
 - DD. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying the raceways to receptacle or fixture ground terminals.
 - 1. Select each surface raceway outlet box, to which a lighting fixture is attached, of sufficient diameter to provide a seat for the fixture canopy.
 - 2. Where a surface raceway is used to supply a fluorescent lighting fixture having central-stem suspension with a backplate and a canopy (with or without extension ring), no separate outlet box is required.
 - 3. Provide surface metal raceway outlet box, and the backplate and canopy, at the feed-in location of each fluorescent lighting fixture having end-stem suspension.
 - 4. Where a surface metal raceway extension is made from an existing outlet box on which a lighting fixture is installed, no additional surface-mounted outlet box is required. Provide a backplate slightly smaller than the fixture canopy.
 - EE. Set floor boxes level and adjust to finished floor surface.

- FF. Select paragraph above for metal floor boxes and below for nonmetallic floor boxes.
- GG. Set floor boxes level and trim after installation to fit flush to finished floor surface.
- HH. Install hinged-cover enclosures and cabinets plumb. Support at each corner.
- II. NO PVC CONDUIT ALLOWED ABOVE THE CEILING OR IN THE A/C RETURN PLENUM. PROVIDE RIGID CONDUIT. Verify all MEP documents.

3.4 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure coatings, finishes, and cabinets are without damage or deterioration at the time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.5 CLEANING

A. On completion of installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART1 -GENERAL

1.1 RELATED REQUIREMENTS

A. The General Provisions, Supplemental General Provisions, Special Provisions and Specification sections, apply to work covered by this Section.

1.2 SCOPE OF WORK

- A. Provide labor, materials, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of all site electrical work.
- B. The site electrical work shall include, but not be limited to, the furnishing and installation of necessary materials and making arrangements for:
 - 1. The connection of electrical and telephone utilities.
 - 2. Underground conduit.
- 1.3 SUBMITTALS
 - A. Submit product data and shop drawings in accordance with Section for products specified under PARTS 2 PRODUCTS.
- 1.4 REFERENCE STANDARDS
 - A. National Electrical Code (NEC), Article 300
 - B. Service installation standards of the serving utility company(s).

PART 2 - PRODUCTS

- 2.1 ELECTRICAL SERVICE
 - A. Coordination: The location of the service entrance shall be coordinated with all other trades. Provide materials and equipment required to connect the electrical service. Contractor shall coordinate with the Power Company for all requirements prior to bid date. Contractor shall include all cost to for Utility Company to extend service to project site bid.
 - B. Materials: Provide materials in accordance with other Sections of these Specifications.
- 2.2 COMMUNICATION SERVICE
 - A. Coordination: The location of the telephone, cable, and internet service entrance shall be coordinated with all other trades. Provide materials and equipment required to connect the telephone, cable and internet services. Contractor shall coordinate with the Telephone , cable, and internet company for all requirements prior to bid date. Contractor is responsible to coordinate with utility companies.
 - B. Materials: Provide materials in accordance with other sections of this specification.

PART 3 - EXECUTION

- 3.1 GENERAL
 - A. Underground installation of more than one conduit shall be in a duct arrangement as indicated. All conduits shall be laid so joints are staggered. All bends and stub-ups shall be rigid steel.
 - B. Pour a red colored concrete envelope 3" thick over utility service, emergency generator and fire pump conduits. Where conduits cross a driveway, road or parking area, reinforcing rods shall be installed.
 - C. Perform excavation, shoring, backfilling and concrete work in connection with electrical work in accordance with other sections of the Specifications.
 - D. All conduit shall be sloped away from the building to negate water entering the building through the conduit system.
- 3.2 UTILITIES

- A. The locations, elevations and voltage of electrical lines and the location of the telephone lines included within the area of this work are indicated on the Drawings or in the Specifications in accordance with information received by the Architect/Engineer and Owner.
- B. The Contractor shall examine the site and shall verify, to his own satisfaction, the location and elevation of all utilities, and shall adequately inform himself as to their relation to the work.
- C. Existing utility lines not indicated but encountered during construction shall be protected, relocated or capped as directed by the Architect/Engineer. All precautions shall be exercised to prevent damage to existing lines not shown, but should work become necessary, it must be authorized prior to execution except in an emergency situation.
- D. Before beginning excavations of any nature whatsoever, the Contractor shall make an attempt to locate all underground utilities of every nature occurring within the bounds of the area to be excavated. Contractor is responsible to call 811 prior to any work. The Contractor shall then proceed with caution in his excavation work so that no utility shall be damaged with a resultant loss of service.
- E. Should a damage result to any utility through the Contractor's negligence or failure to comply with the above directive, he shall be liable for such damage and for all expense incurred in the expeditious repair or replacement of such damaged utilities.
- F. Repair of damaged utilities shall be to a condition equal to or better than the adjacent undamaged portion of such utility and to the complete satisfaction of the Architect/Engineer and Owner.

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions and Specification sections, apply to work covered by this Section.
- B. Comply with ELECTRICAL Sections, as applicable. Refer to other sections for coordination of work.

1.2 SCOPE OF WORK

- A. Provide labor, material, equipment, tools and services, and perform operations required for, and reasonably incidenta
- B. Provide electrical identification for the following:
- 1. Panelboards, motor starters, contactors, disconnect switches, circuit breakers and other electrical equipment with nameplate identifying the item of equipment and the equipment serving the same.
- 2. Raceways, junction boxes and pull boxes.
- 3. Label each panelboard index indicating the room #s to the related circuit. Also add the index sheet in a laminated white core, plastic with beveled edges, minimum 1/16 inch thick. Lettering shall be machine-engraved, not less than 1/4" high, cut through the black or red surface to the white core.
- 4. Wiring devices.
- 5. Wiring.
- 6. Three phase motor rotation.
- 1.3 SUBMITTALS

A. Submit product data in accordance with Section for products specified under PART 2 - PRODUCTS. PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Brady
- B. Panduit
- C. Thomas & Betts
- D. Seton
- 2.2 IDENTIFICATION

A.

Nameplates

- 1. Nameplates shall be black engraved surface on white core for normal power circuits and red engraved surface on white core for emergency power circuits.
- 2. Provide for each distribution panelboard, branch circuit panelboard, transformer and any other similar equipment furnished under this section identification as to its given name, voltage and origination of service. Examples are as follows:

'LR1'	'LR2'
120/240V	120/240V
FED FROM 'MDP'	FED FROM 'MDP'

3. Provide for each motor starter enclosure, circuit breaker enclosure, disconnect switch and any other similar

equipment furnished under this section, identification as to the specific load that it serves and the origination of service. Examples are as follows:

'AHU-1' 'CU-1' FED FROM 'MDP' FED FROM 'MDP'

- 1. Provide for each feeder protective device in each distribution panelboard and any other similar equipment furnished under this section, identification as to the specific load that it serves.
- 2. Nameplates shall be laminated, white core, plastic with beveled edges, minimum 1/16 inch thick. Lettering shall be machine-engraved, not less than 1/4" high, cut through the black or red surface to the white core.

B.Junction Boxes and Pull Boxes

1. 1. Identification shall be with a black permanent marking pen on the top of 4" x 4" junction box covers or on the back of an outlet box cover plate identifying the branch circuits and systems within the conduit. Pull boxes shall be provided with a nameplate stating voltage and system served.

C.Wiring Device Wall Plates

- 1. 1. On the back side of wiring device wall plates identify with a black permanent marking pen the panelboard and branch circuit number the device is served from.
- D. Wire Markers
- 2. 1. Wire markers for identification of wiring shall be self-adhesive type having letters and numerals indicating serving equipment and feeder or branch circuit number.

Rotation Tags

1. Rotation tags shall be brass or aluminum securely attached to equipment.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surfaces to receive labels or nameplates shall be carefully prepared in accordance with the manufacturer's instructions and recommendations.

3.2 NAMEPLATES

A. Nameplates shall be properly attached to identify panelboards, feeder circuit breakers, disconnect switches, pull boxes and other similar equipment furnished under this section.

3.3 WIRE MARKERS

A. Wire markers shall be applied to each conductor or cable within panelboards, motor starter enclosures, circuit breaker enclosures, disconnect switches, cabinets, junction boxes, pull boxes, and other similar equipment identifying the serving equipment and feeder or branch circuit from which the conductors originate.

SECTION 26 05 73.13

SHORT-CIRCUIT STUDIES

1.1 SUMMARY

A. Section includes a computer-based, short-circuit study to determine the minimum required short-circuit ratings for all electrical equipment.

1.2 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged, or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.
- B. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- C. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- D. Power Systems Analysis Specialist: Professional or qualified engineer in charge of performing the study and documenting recommendations.
- E. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.
- F. SCCR: Short-circuit current rating.
- G. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- H. Single-Line Diagram: See "One-Line Diagram."

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Submit information on computer software program to be used for studies.
 - 2. Submit the following after the approval of system submittals. Submittals [shall] [may] be in digital form.
 - a. Short-circuit study input data, including completed computer program input data sheets.
 - b. Short-circuit study and equipment duty evaluation report; signed and dated by a professional or qualified engineer.
 - Submit study report for action prior to receiving final approval of distribution equipment submittals. If completion of studies will cause delay in equipment manufacturing, obtain approval from Owner for preliminary submittal of sufficient accuracy to ensure that selection of devices and associated characteristics is satisfactory. All assumptions made in a preliminary submittal shall be clearly identified.
- 2) Revised one-line diagram, reflecting any discrepancies noted or updates required based on data collected for the study.
- 3) Study report shall include documentation of all equipment data used in the short-circuit and equipment duty analysis.
- 4) Study shall include a detailed listing of any electrical equipment found to be underrated for the calculated fault duty.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
 - 1. For Power Systems Analysis Software.
 - 2. For Power System Analysis Specialist.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:
 - 1. Final Short-Circuit Study Report:
 - a. Final one-line diagram.
 - b. Final Equipment Duty Report.
 - c. Short-circuit study data files.
 - d. Power system data.
 - e. Software data file in electronic format compatible with the software version used in the study.
 - f. Software library data used for the study.

1.6 QUALITY ASSURANCE

- A. Study shall be performed using commercially developed and distributed electrical power system analysis software.
- B. Software algorithms and methodology shall comply with requirements of applicable standards and guides specified in this Section.
- C. Manual calculations are unacceptable.
 - 1. Power System Analysis Software Qualifications: Computer program shall be designed to perform ANSI and IEC based short-circuit studies or have a function, component, or add-on module designed to perform short-circuit studies.
- D. Power Systems Analysis Specialist Qualifications: Professional Engineer licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this Professional Engineer.
- E. Short-Circuit Study Certification: Short-Circuit Study Report shall be signed by Power Systems Analysis Specialist.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide EasyPower, LLC software with ANSI ShortCircuit, IEC ShortCircuit, Scenario Manager, SmartDuty and SmartBreaker or comparable product by one of the following:
 - 1. CGI CYME.
 - 2. Power Analytics, Corporation.
 - 3. <Insert manufacturer's name>.
- B. Comply with IEEE 399 and IEEE 551.
 - 1. Analytical features of power systems analysis software program shall have capability as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

- A. Executive summary of study findings.
- B. Detailed list of all electrical equipment found to be underrated for the available short-circuit current.
- C. Recommendations for resolving any issues found with underrated equipment.
- D. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- E. One-line diagram of modeled power system, indicating the following:
 - 1. Protective device designations and ampere ratings.
 - 2. Conductor types, sizes, and lengths.
 - 3. Transformer size and impedance.
 - 4. Motor and generator designations and ratings.
 - 5. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
 - 6. Any revisions to electrical equipment required by the study.
- F. Protective Device Evaluation:
 - 1. Evaluate equipment and protective devices and compare to available short-circuit currents. Verify that equipment short-circuit ratings exceed available short-circuit current based on the applicable standards.
 - 2. Tabulations of circuit breaker, fuse, and other protective device short-circuit ratings versus calculated short-circuit duties.
 - 3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
- G. Short-Circuit Study Input Data:
 - 1. One-line diagram of system being studied.

- 2. Utility or incoming power short-circuit data.
- 3. Manufacturer, model, and short-circuit rating of protective devices.
- 4. Conductors.
- 5. Transformer data.
- H. Short-Circuit Study Output Reports:
 - 1. Low-Voltage Fault Report: Three-phase and single line to ground fault calculations, indicating the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. Multiplying factor.
 - 2. High-Voltage Momentary Short-Circuit Report: Three-phase and single line to ground fault calculations, indicating the following for each equipment location:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. Calculated asymmetrical fault currents:
 - 1) Based on fault-point X/R ratio.
 - 2) Based on calculated symmetrical value multiplied by 2.6.
 - 3. High-Voltage Interrupting Short-Circuit Report: Three-phase and single line to ground fault calculations, indicating the following for each equipment location:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. No AC Decrement (NACD) ratio.
 - 4. Equipment Duty Report: For each protective device, indicate short-circuit ratings and calculated equipment duty for both ½ cycle and interrupting ratings as applicable. Calculated duty must automatically take into account any necessary derating factor due to the system X/R ratio and based on the actual maximum fault current through each device rather than the total bus fault current. All calculations to be based on the specific applicable test standards for each device such that no further interpretation of the results is necessary.

PART 3 - EXECUTION

3.1 POWER SYSTEM DATA

- A. Obtain all data necessary for conduct of the study.
 - 1. Verify completeness of data supplied on one-line diagram. Call any discrepancies to Owner's attention.
 - 2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.

- 3. For [equipment that] [relocated equipment and that which] is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers.
- B. Gather and tabulate the required input data to support the short-circuit study. Comply with requirements in Section 017839 "Project Record Documents" for recording circuit protective device characteristics. Record data on a Record Document copy of one-line diagram. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or their representative. Data must include, but not be limited to, the following:
 - 1. Product Data for Project's overcurrent protective devices. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Obtain electrical power utility impedance at each service from the serving utility.
 - 3. For transformers, include kVA ratings, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
 - 4. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
 - 5. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
 - 6. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
 - 7. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
 - 8. Motor horsepower and NEMA MG 1 code letter designation.
 - 9. Conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.2 SHORT-CIRCUIT STUDY

- A. Perform study following the general study procedures contained in IEEE 399.
- B. Calculate short-circuit currents in accordance with IEEE 551.
- C. Base study on device characteristics supplied by device manufacturer.
- D. Extent of electrical power system to be studied is indicated on Drawings.
- E. Begin the scope of the short-circuit current and equipment duty analysis at the service, extending down to system overcurrent protective devices as follows:
 - 1. Down to and including all three-phase panelboards at voltages 208 V ac or higher.
 - 2. <Insert description>.
- F. For systems with multiple sources or multiple operating conditions, evaluate short-circuit and equipment duty for multiple scenarios as necessary to determine the maximum short-circuit current at each location.
- G. Analysis software must factor in ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply this to the short-circuit and equipment duty calculations as recommended by applicable standards. Also account for the fault-current dc decrement to address asymmetrical current ratings of applicable electrical equipment and components.
- H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on one-line diagram.

- I. Equipment duty report must clearly indicate any protective device that is being applied outside its short-circuit rating.
- J. For any equipment found to be underrated, the report shall include recommendations for resolving this deficiency.

END OF SECTION

SECTION 26 05 73.19

ARC-FLASH HAZARD ANALYSIS

1.1 SUMMARY

A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard boundary distance and the incident energy to which personnel could be exposed during work on or near energized electrical equipment.

1.2 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- C. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- D. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- E. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- F. SCCR: Short-circuit current rating.
- G. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- H. Single-Line Diagram: See "One-Line Diagram."

1.3 ACTION SUBMITTALS

- A. Product Data: Submit information regarding computer software program to be used for studies.
- B. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form:
 - 1. Arc-flash study report; signed, dated, and sealed by Power Systems Analysis Specialist.
 - 2. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
 - 3. Exported data from computer-based, one-line diagram detailing the system data used for the arc-flash calculations, provided in .csv or Microsoft Excel format.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
 - 1. For Power Systems Analysis Software Developer.
 - 2. For Power System Analysis Specialist.
- B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.5 CLOSEOUT SUBMITTALS

- A. Arc-Flash Hazard Analysis:
 - 1. Provide final arc-flash hazard analysis report in hard copy and digital format.
 - 2. Provide digital file containing electrical system model in a format consistent with power system analysis software used to perform study.
 - 3. Provide library files for power system analysis software used to perform study.

1.6 QUALITY ASSURANCE

- A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.
- D. Power System Analysis Software Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 - 1. Computer program shall be designed to perform arc-flash analysis.
- E. Power Systems Analysis Specialist Qualifications: Professional or qualified engineer in charge of performing the arc-flash study, analyzing the arc-flash results, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional or qualified engineer.
- F. Arc-Flash Study Certification: Arc-Flash Study Report shall be signed and sealed by Power Systems Analysis Specialist.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide software developed and sold by EasyPower software with ANSI ShortCircuit, ArcFlash, PowerProtector, Scenario Manager, SmartDuty and SmartBreaker or comparable product by one of the following:

- 1. CGI CYME.
- 2. Power Analytics, Corporation.
- B. Software must provide results consistent with the requirements of the latest versions of IEEE 1584 and NFPA 70E.
- C. Software capable of creation and storage of unlimited number of operating scenarios. All scenarios stored in the same project model file. System changes made to the base case automatically propagated to each operating scenario.

2.2 ARC-FLASH STUDY REPORT CONTENT

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram, indicating the following:
 - 1. Protective device designations, locations, and ampere ratings.
 - 2. Conductor types, sizes, and lengths.
 - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 - 4. Motor and generator ratings.
 - 5. Switchgear, switchboard, motor-control center, and panelboard designations.
 - 6. Utility sources.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Equipment Duty Report: As specified in Section 260573.13 "Short-Circuit Studies."
- F. Data on all protective devices; manufacturers, types, sizes and adjustable settings that were used for the arc-flash calculations.
- G. List of protective devices found to be inoperable or with signs of impending failure. These devices must be clearly listed and excluded from use in determination of the arc time.
- H. Equipment Duty Study: Report to verify that all protective devices have adequate short-circuit ratings to interrupt the calculated maximum short-circuit current.
- I. Arc-Flash Study Calculations and Output Reports:
 - 1. Arcing fault magnitude.
 - 2. Protective device clearing time.
 - 3. Duration of arc.
 - 4. Arc-flash boundary.
 - 5. Restricted approach boundary.
 - 6. Limited approach boundary.
 - 7. Working distance.
 - 8. Incident energy.
- J. Arc-Flash Study input data, scenario descriptions, and arc-flash calculations including a definition of terms and guide for interpretation of the arc-flash hazard report. Study input data must be provided in electronic form as .csv or Excel files.

2.3 ARC-FLASH WARNING LABELS

- A. Provide a weatherproof, self-adhesive equipment label for each location requiring arc-flash hazard identification.
 - 1. Minimum Size: 6 inches (150 mm) wide by 4 inches (100 mm) high.
 - 2. Sample label submitted for review prior to printing of actual labels.
- B. Content: Orange header with the wording, "WARNING, ARC-FLASH HAZARD, Arc-Flash and Shock Risk Assessment, Appropriate PPE Required." and the following information taken directly from the arc-flash hazard analysis:
 - 1. Equipment ID.
 - 2. Nominal voltage.
 - 3. Protection boundaries.
 - a. Arc-flash boundary.
 - b. Restricted approach boundary.
 - c. Limited approach boundary.
 - 4. Available incident energy.
 - 5. Working distance.
 - 6. Engineering report number, revision number, and issue date.
- C. Completely machine printed, no field-applied markings.
- D. Compliance: NFPA 70E.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project electrical equipment submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study. The report shall clearly state any assumptions that were necessary to complete the analysis.

3.2 ARC-FLASH HAZARD ANALYSIS

- A. Comply with the latest versions of NFPA 70E for the arc-flash hazard analysis study.
- B. Study all operating scenarios to determine the maximum incident energy at each location.
- C. Submit proposed arc-flash analysis scenarios for review prior to performing arc-flash calculations. Arc-flash hazard analysis report shall indicate which scenario created the maximum arc-flash energy for each location. All arc-flash calculations must be performed in accordance with the procedures and recommendations contained in the latest version of IEEE 1584. Calculate the arc-flash hazard boundary and incident energy at all locations in electrical distribution system where personnel could service or examine equipment while energized.
- D. Include all three-phase medium- and low-voltage equipment locations.

- E. Calculate the limited and restricted approach boundaries for each location.
- F. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources or fault current that changes with time during the fault. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented based on the recommendations in IEEE 399 and ANSI C37 where applicable.
- G. Arc-flash energy shall generally be reported for the maximum of line or load side of a circuit breaker. However, arc-flash computation shall be performed and reported for both line and load side of a circuit breaker as follows:
 - 1. When the circuit breaker is in a separate enclosure.
 - 2. When the line terminals of the circuit breaker are separate from the work location.
- H. Base arc-flash calculations on the time-current curve or operating time of the fastest upstream device using the predicted arcing current through that device. For medium-voltage circuit breakers, the breaker interrupting time must be automatically added to the relay operating time. Based on the recommendations in IEEE 1584 and sound engineering judgment, a maximum arc time of two seconds can be applied for situations where the protective device operating time is found to exceed two seconds.

3.3 POWER SYSTEM DATA

- A. Obtain all data necessary for conduct of the arc-flash hazard analysis.
 - 1. Verify completeness of data supplied on one-line diagram on Drawings. Call any discrepancies or missing information to Owner's attention.
 - 2. For new equipment, use characteristics from approved submittals under provisions of action submittals and information submittals for this Project.
 - 3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys conducted by qualified technicians and engineers.
- B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer. Data shall include, but are not limited to, the following:
 - 1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Obtain electrical power utility impedance or available short-circuit current at each service.
 - 3. Short-circuit current at each system bus (three phase and line to ground).
 - 4. Voltage level at each bus.
 - 5. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio if available, tap settings, and phase shift.
 - 6. For reactors, provide manufacturer and model designation, voltage rating and impedance.
 - 7. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, short-circuit rating, continuous current rating, and settings for all adjustable settings.

- 8. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
- 9. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
- 10. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
- 11. Motor horsepower.
- 12. Low-voltage conductor sizes, lengths, number, conductor material, and conduit material.
- 13. Medium-voltage conductor sizes, lengths, conductor material, conductor construction and metallic shield performance parameters, and conduit material.

3.4 LABELING

- A. Apply one arc-flash label on the front cover of each section of the equipment and on side or rear covers with accessible live parts and hinged doors or removable plates for each equipment included in the study. Base arc-flash label data on highest values calculated at each location.
- B. Each piece of equipment listed below shall have an arc-flash label applied to it:
 - 1. Motor-control center.
 - 2. Low-voltage switchboard.
 - 3. Switchgear.
 - 4. Medium-voltage switch.
 - 5. Low voltage transformers.
 - 6. Panelboard.
 - 7. Safety switch.
 - 8. Fused disconnect switch.
 - 9. Enclosed circuit breaker.
 - 10. Adjustable frequency drive.
 - 11. Control panel.

3.5 APPLICATION OF WARNING LABELS

A. Install arc-flash warning labels under the direct supervision and control of Power System Analysis Specialist.

3.6 DEMONSTRATION

A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in potential arc-flash hazards associated with working on energized equipment and the interpretation of arc-flash warning labels.

END OF SECTION

SECTION 26 09 23

LIGHTING CONTROL SYSTEM

PART 1 – GENERAL

1.0 SECTION INCLUDES

- A. Network lighting control system and components:
 - 1. Touch panel controls
 - 2. Lighting management panels
 - 3. Lighting management modules
 - 4. Low voltage wall stations
 - 5. Power interfaces
 - 6. Wired sensors

1.1. RELATED DOCUMENTS

- A. Section 262726 Wiring Devices
- B. Section 260923 Lighting Control Devices
- C. Section 260943.13 Digital-Network Lighting Controls
- D. Section 260943.16 Addressable Fixture Lighting Control
- E. Section 260943.19 Wireless Network Lighting Controls
- F. Section 265113 Interior Lighting Fixtures

1.2. SUMMARY

- A. The lighting control system specified in this section shall provide time-based, sensor-based (both occupancy and daylight), and manual lighting control
- B. The system shall be capable of turning lighting loads on/off as well as dimming lights (if lighting load is capable of being dimmed). Specific dimmers will be capable of "dimming lights to off"
- C. All system devices shall be networked together, enabling digital communication between devices, and shall be individually addressed.
- D. The system architecture shall be capable of enabling stand-alone groups (rooms) of devices to function in some default capacity, even if network connectivity to the greater system is lost.
- E. The system architecture shall facilitate remote operation via a computer connection.
- F. The system shall not require any centrally hardwired switching equipment.
- G. The system shall be capable of wireless, wired, or hybrid wireless/wired architectures.

1.3 SUBMITTALS

- A. Product Datasheets (general device descriptions, dimensions, electrical specifications, wiring details, nomenclature)
- B. Riser Diagrams typical per room type (detailed drawings showing device interconnectivity of devices)
- C. Other Diagrams as needed for special operation or interaction with other system(s)
- D. Example Contractor Startup/Commissioning Worksheet must be completed prior to factory start-up
- E. Hardware and Software Operation Manuals
- F. Other operational descriptions as needed

1.4 PROJECT CLOSEOUT DOCUMENTATION

- A. Provide a factory published manual
 - 1. Warranty

- 2. Technical support contact
- 3. Electronic manual on manufacturer's website for free download

1.5 QUALITY ASSURANCE

- A. All steps in sensor manufacturing process shall occur in North America; including population of all electronic components on circuit boards, soldering, programming, wiring, and housing.
- B. All components and the manufacturing facility where product was manufactured must be RoHS compliant.
- C. In high humidity or cold environments, the sensors shall be conformably coated and rated for condensing humidity and -40 degree Fahrenheit (and Celsius) operation.
- D. All applicable products must be UL / CUL Listed or other acceptable national testing organization.

1.6 PROJECT CONDITIONS

- A. Only install equipment after the following site conditions are maintained:
 - 1. Ambient Temperature 14 to 105 degrees F (-10 to 40 degrees C)
 - 2. Relative Humidity less than 90% non-condensing
- B. Standard electrical enclosures are permanently installed
- C. Equipment is protected from dust, debris and moisture

1.7 WARRANTY

A. Five (5) year 100% parts replacement

1.8 MAINTENANCE & SUSTAINABILITY

- A. Provide new parts, upgrades, and/or replacements available for a minimum of 5 years available to the end user
- B. Provide free telephone technical support

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable: Acuity Brands Lighting, Inc. System: nLight by Acuity Controls
- B. Basis of controls design Manufacturer: Acuity Brands, One Lithonia Way, Conyers GA 30012, www.acuitycontrols.com
- C. Substitutions: Not Permitted {Under Division 1}:
 - 1. All substitutions must be submitted in writing for approval at least 14 days prior to bid date.
 - 2. Proposed substitute products must be documented with a line by line compliance review

2.2 SYSTEM REQUIREMENTS

- A. System shall have an architecture that is based upon three main concepts; 1) intelligent lighting control devices 2) standalone lighting control zones 3) network backbone for remote or time based operation.
- B. Intelligent lighting control devices shall consist of one or more basic lighting control components; occupancy sensors, photocell sensors, relays, dimming outputs, manual switch stations, and manual dimming stations. Combining one or more of these components into a single device enclosure should be permissible so as to minimize overall device count of system.
- C. System must interface directly with intelligent LED luminaires such that only CAT-5 cabling is required to interconnect luminaires with control components such as sensors and switches (see *Networked LED Luminaire* section).

- D. Intelligent lighting control devices shall communicate digitally, require <7 mA of current to function (Graphic wall stations excluded), and possess RJ-45 style connectors.
- E. Lighting control zones shall consist of one or more intelligent lighting control components, be capable of stand-alone operation, and be capable of being connected to a higher level network backbone.
- F. Devices within a lighting control zone shall be connected with CAT-5e low voltage cabling in any order.
- G. Lighting control zone shall be capable of automatically configuring itself for default operation without any start-up labor required.
- H. Individual lighting zones must continue to provide a user defined default level of lighting control in the event of a system communication failure with the backbone network or the management software becoming unavailable.
- I. Power for devices within a lighting control zone shall come from either resident devices already present for switching (relay device) or dimming purposes, controls enabled luminaires, or from the network backbone. Standalone "bus power supplies" shall not be required in all cases.
- J. All switching and dimming for a specific lighting zone shall take place within the devices located in the zone itself (i.e. not in remotely located devices such as panels) to facilitate system robustness and minimize wiring requirements. Specific applications that require centralized or remote switching shall be capable of being accommodated.
- K. System shall have one or more primary wall mounted network control "gateway" devices that are capable of accessing and controlling connected system devices and linking into an Ethernet LAN.
- L. System shall use "bridge" devices that route communication and distribute power for up to 8 directly connected lighting zones together for purposes of decreasing system wiring requirements.
- M. System shall be capable of wirelessly connecting a lighting zone to a WiFi (802.11n) wireless data network for purposes of eliminating the "bridge" devices and all cabling that connects zones to bridge devices.
- N. WiFi enabled devices shall be able to detect when WiFi network is down and revert to a user directed default state.
- O. WiFi-enabled devices shall be capable of current monitoring
- P. WiFi-enabled devices shall utilize WPA2 AES encryption
- Q. WiFi-enabled devices shall be able to connect to 802.11b/g/n WiFi networks
- R. WiFi-enabled devices shall have two local RJ-45 port for communicating with non WiFi-enabled system devices
- S. System shall have a web-based software management program that enables remote system control, status monitoring, and creation of lighting control schedules and profiles.
- T. Individual lighting zones shall be capable of being segmented into several "local" channels of occupancy, photocell, and switch functionality for more advanced configurations and sequences of operation.
- U. Devices located in different lighting zones shall be able to communicate occupancy, photocell (nondimming), and switch information via either the wired or WiFi backbone.
- V. System shall be capable of operating a lighting control zone according to several sequences of operation. System shall be able to change a spaces sequence of operation according to a time schedule so as to enable customized time-of-day, day-of-week, utilization of a space. Note: Operating modes should be utilized only in manners consistent with local energy codes.
 - 1. Auto-On / Auto-Off (via occupancy sensors)

• Zones with occupancy sensors automatically turn lights on when occupant is detected.

• Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.

• Pressing a switch will turn lights off. The lights will remain off regardless of occupancy until switch is pressed again, restoring the sensor to Automatic On functionality.

2. Manual-On / Auto-Off (also called Semi-Automatic)

• Pushing a switch will turn lights on.

• Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.

3. Manual-On to Auto-On/Auto-Off

• Pushing a switch will turn lights on.

• After initial lights on, zones with occupancy and/or photocell sensors turn lights on/off according to occupancy/vacancy and/or daylight conditions.

• Sequence can be reset via scheduled (ex. daily each morning) events.

4. Auto-to-Override On

• Zones with occupancy sensors automatically turn lights on when occupant is detected.

• Zone lighting then goes into an override on state for a set amount of time, or until the next time event returns the lighting to an auto-off style of control.

• Sequence can be reset via scheduled (ex. daily each morning) events.

5. Manual-to-Override On

• Pushing a switch will turn lights on.

• Zone lighting then goes into an override on state for a set amount of time or until the next time event returns the lighting to an auto-off style of control.

• Sequence can be reset via scheduled (ex. daily each morning) events.

6. Auto On / Predictive Off

• Zones with occupancy sensors automatically turn lights on when occupant is detected.

• Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.

• Pressing the switch will turn the lights off and a short "exit timer" begins. After

the timer expires, sensor scans the room to detect whether occupant is still present. If no occupancy is detected, zone returns to auto-on. If occupancy is detected, lights must be turned on via the switch.

7. Multi-Level Operation (multiple lighting levels per manual button press)

• Operating mode designed specifically for bi-level applications.

• Enables the user to cycle through up to four potential on/off/dim low/dim high lighting states using only a single button.

• Eliminates user confusion as to which of two buttons controls which load

• Three different transition sequences are available in order to comply with energy codes or user preference).

• Mode available as a setting on all devices that have single manual on/off switch (ex. nPODM, nPODM-DX, nWSX LV).

• Depending on the sequence selected, every button push steps through relay/dimming states according to below table

• In addition to achieving bi-level lighting control by switching loads with relays,

the ability to command dimming outputs to "step" in a sequence that achieves bi-level operation is present.

		State	State of load after each pushbutton press			
MLO Mode		1st Press	2nd Press	3rd Press	4th Press	
2-State (Alternating)	Load A	On	Off Off		-	
	Load B	Off	On	Off	-	
2-State (Both On, A First)	Load A	On	On Off		-	
	Load B	Off	On	Off	-	
2-State (Both On, B First)	Load A	Off	On Off		-	
	Load B	On	On	Off	-	
3-State	Load A	On	Off On		Off	
	Load B	Off	On	On	Off	
A and B On ¹	Load A	On	Off	-	-	
	Load B	On	Off	-	-	
A On Only ¹	Load A	On	Off	-	-	
	Load B	Off	Off	-	-	
A and B On & Dim High ¹	Load A	High	Off	-	-	
	Load B	High	Off	-	-	
Dim Low /High	Load A	Low	High	Off	-	
Dim Low / High	Load A	High	Low Off -		-	

NOTE 1: Modes for use only when Auto-On state of Load A & B is different than first MLO state

- W. A taskbar style desktop application shall be available for personal lighting control.
- X. An application that runs on "smart" handheld devices (such as an Apple® IPhone®) shall be available for personal lighting control.
- Y. Control software shall enable logging of system performance data and presenting thisl information in a web-based format and downloadable to .CSV files.
- Z. Control software shall enable integration with a BMS via BACnet IP, although a hardware BACnet IP integration solution is also available.
- AA.System shall provide the option of having pre-terminated plenum rated CAT-5e cabling supplied with hardware.

2.3 INDIVIDUAL DEVICE SPECIFICATIONS

- A. Control module (gateway)
 - 1. Control module shall be a device that facilitates communication and time-based control of downstream network devices and linking into an Ethernet network.
 - 2. Devices shall have a user interface that is capable of wall mounting, powered by low voltage, and have a touch screen.
 - Control device shall have three RJ-45 ports for connection to the graphic touch screen, other backbone devices bridges) or directly to lighting control devices(up to 128 per port).
 - 4. Device shall automatically detect all devices downstream of it.
 - 5. Device shall have a standard and astronomical internal time clock.
 - 6. Device shall have one RJ-45 10/100 BaseT Ethernet connection.
 - 7. Device shall have a USB port

- 8. Each control gateway device shall be capable of linking 1500 devices to the management software, with reduced memory version capable of support up to 400 devices.
- 9. Device shall be capable of using a dedicated static or DHCP assigned IP address.
- 10. Network Control Gateway device shall be the following nLight model Series: nGWY2
- B. Networked system occupancy sensors
 - 1. Occupancy sensors shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.
 - Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state, thus preventing false on conditions. Ultrasonic or Microwave based sensing technologies shall not be accepted.
 - 3. For applications where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions), a sensor with an additional "dual" technology shall be used.
 - 4. Dual technology sensors shall have one of its two technologies not require motion to detect occupancy. Acceptable dual technology includes PIR/Microphonics (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants. Sensors where both technologies detect motion (PIR/Ultrasonic) shall not be acceptable.
 - 5. All sensing technologies shall be acoustically passive, meaning they do not transmit sounds waves of any frequency (for example in the Ultrasonic range), as these technologies have the potential for interference with other electronic devices within the space (such as electronic white board readers). Acceptable detection technologies include Passive Infrared (PIR), and/or Microphonics technology. Ultrasonic or Microwave based sensing technologies shall not be accepted.
 - 6. Sensors shall be available with zero or one integrated dry contact switching relays, capable of switching 1 amp at 24 VAC/VDC (resistive only).
 - 7. Sensors shall be available with one or two occupancy "poles", each of which provides a programmable time delay.
 - 8. Sensors shall be available in multiple lens options which are customized for specific applications.
 - 9. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
 - 10. All sensors shall have two RJ-45 ports or capable of utilizing a splitter.
 - 11. All sensors shall have the ability to detect when it is not receiving valid communication (via CAT-5 connections) and blink its LED in a pattern to visually indicate of a potential wiring issue
 - 12. Every sensor parameter shall be available and configurable remotely from the software and locally via the device push-button.
 - 13. Sensors shall be able to function together with other sensors in order to provide expanded coverage areas by simply daisy-chain wiring together the units with CAT-5 cabling.
 - 14. Sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements.
 - 15. Wall switch sensors shall recess into single-gang switch box and fit a standard GFI opening.
 - 16. Wall switch sensors must meet NEC grounding requirements by providing a dedicated ground connection and grounding to mounting strap. Line and load wire connections

shall be interchangeable. Sensor shall not allow current to pass to the load when sensor is in the unoccupied (Off) condition.

- 17. Wall switch sensors shall have optional features for photocell/daylight override, and low temperature/high humidity operation.
- 18. Wall switch sensors shall be available in four standard colors (Ivory, White, Light Almond, Gray)
- 19. Wall switch sensors shall be available with optional raise/lower dimming adjustment controls.
- 20. Wall switch sensors shall be the following nLight model numbers, with device color and optional features as specified:

nWSX (PIR, 1 Relay) nWSX PDT (Dual Tech, 1 Relay) nWSX LV (PIR, No Relay) nWSX PDT LV (Dual Tech, No Relay) nWSX LV NL (PIR w/ Night Light, No Relay) nWSX PDT LV NL (Dual Tech w/ Night Light, No Relay) nWSX LV DX (PIR, No Relay, Raise/Lower Dim Ctrl) nWSX PDT LV DX (Dual Tech, No Relay,Raise/Lower Dim Ctrl)

- 21. Network system shall have sensors that can be embedded into luminaire such that only the lens shows on luminaire face.
- 22. Embedded sensors shall be capable of both PIR and Dual Technology occupancy detection
- 23. Embedded sensors shall have an optional photocell
- 24. Embedded sensors shall be the following nLight model number:

nES 7 (PIR, No Relay) nES 7 ADCX (PIR w/ Photocell, No Relay) nES PDT 7 (Dual Technology, No Relay) nES PDT 7 ADCX (Dual Technology w/ Photocell, No Relay)

- 25. Network system shall also have ceiling, fixture, recessed, & corner mounted sensors available.
- 26. Sensors shall have optional features for photocell/daylight override, dimming control, and low temperature/high humidity operation.
- 27. Sensors shall be the following nLight model numbers, with device options as specified:

Model # Series	Occupancy Poles	# of Relays	Lens Type	Detection Technology
nCM(B) 9	1	-	Standard	PIR
nCM(B) 9 2P	2	-	Standard	PIR
nCM 9 RJB	1	-	Standard	PIR
nCM 9 2P RJB	2	-	Standard	PIR
nCM(B) PDT 9	1	-	Standard	Dual
nCM(B) PDT 9 2P	2	-	Standard	Dual
nCM PDT 9 RJB	1	-	Standard	Dual
nCM PDT 9 2P RJB	2	-	Standard	Dual
nCM(B) 10	1	-	Extended	PIR
nCM(B) 10 2P	2	-	Extended	PIR
nCM 10 RJB	1	-	Extended	PIR
nCM 10 2P RJB	2	-	Extended	PIR
nCM(B) PDT 10	1	-	Extended	Dual
nCM(B) PDT 10 2P	2	-	Extended	Dual
nCM PDT 10 RJB	1	-	Extended	Dual
nCM PDT 10 2P RJB	2	-	Extended	Dual
nRM 9	1	-	Standard	PIR
nRM PDT 9	1	-	Standard	Dual
nRM 10	1	-	Extended	PIR
nRM PDT 10	1	-	Extended	Dual
nRM 6	1	-	High Bay	PIR
nRM 50	1	-	Aisle Way	PIR
nWV 16	1	-	Wide View	PIR
nWV PDT 16	1	-	Wide View	Dual
nHW13	1	-	Hallway	PIR
nCM(B) 6	1	-	High Bay	PIR
nCM 6 RJB	1	-	High Bay	PIR

C. Networked system daylight (photocell and/or dimming) sensors

1. Photocell shall provide for an on/off set-point, and a deadband to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.

- 2. Photocell and dimming sensor's set-point and deadband shall be automatically calibrated through the sensor's microprocessor by initiating an "Automatic Set-point Programming" procedure. Min and max dim settings as well as set-point may be manually entered.
- 3. Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).
- 4. Photocell and dimming sensors shall be equipped with an automatic override for100 hour burn-in of lamps. This feature must be available at any time for lamp replacements. (Note: This function should be performed prior to any dimming of the lamps including the "auto set-point" setting.)
- 5. Combination units that have all features of on/off photocell and dimming sensors shall also be available.
- 6. A dual zone option shall be available for On/Off Photocell, Automatic Dimming Control Photocell, or Combination units. The second zone shall be capable of being controlled as an "offset" from the primary zone.
- 7. Sensor shall be the following nLight model numbers, with device options as specified:

nCM(B) PC (RJB) (on/off) nCM(B) PC DZ (RJB) (on/off control, dual zone) nCM(B) ADCX (RJB) (remote automatic dimming control photocell) nCM(B) ADCX DZ (RJB) (remote automatic dimming control photocell, dual zone) nRM PC (on/off) nRM PC DZ (on/off, dual zone) nRM ADCX (remote automatic dimming control photocell) nRM ADCX DZ (remote automatic dimming control photocell, dual zone)

- 8. Network system shall have dimming photocells that can be embedded into luminaire such that only the lens shows on luminaire face.
- 9. Embedded sensors shall be the following nLight model number: nES ADCX (Dimming Photocell)
- D. Networked System Power (Relay) Packs
 - Power Packs shall incorporate one Class 1 relay, a 0-10 VDC dimming output, and contribute low voltage power to the rest of the system. Secondary Packs shall incorporate the relay and 0-10 VDC or line voltage dimming output, but shall not be required to contribute system power. Power Supplies shall provide system power only, but are not required to switch line voltage circuit. Auxiliary Relay Packs shall switch low voltage circuits only.
 - 2. Power Packs shall accept 120 or 277 VAC (or optionally 347 VAC), be plenum rated, and provide Class 2 power to the system.
 - 3. All devices shall have two RJ-45 ports.
 - 4. Every Power Pack parameter shall be available and configurable remotely from the software and locally via the device push-button.
 - 5. Power Pack shall securely mount to junction location through a threaded ½ inch chase nipple or be capable of being secured within a luminaire ballast channel. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.

- 6. When required by local code, Power Pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.
- 7. Power Packs and Power Supplies shall be available that are WiFi enabled.
- 8. Power Packs (Secondary) shall be available that provide up to 16 Amp switching of all lighting load types.
- 9. Power Packs shall be available that provide up to 5 Amps switching of all lighting load types as well as 0-10 VDC dimming or fluorescent ballasts/LED drivers.
- 10. Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120 VAC incandescent lighting loads or 120/277 VAC line voltage dimmable fluorescent ballasts (2-wire and 3-wire versions).
- 11. Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120/277 VAC magnetic low voltage transformers.
- 12. Specific Secondary Packs shall be available that provide up to 4 Amps of switching and can dim 120 VAC electronic low voltage transformers.
- 13. Specific Power/Secondary Packs shall be available that are UL924 listed for switching of Emergency Power circuits.
- 14. Specific Secondary Packs shall be available that control louver/damper motors for skylights.
- 15. Specific Secondary Packs shall be available that provide a pulse on/pulse off signal for purposes of controlling shade systems via relay inputs.
- 16. Power (Secondary) Packs shall be available that provide up to 20 Amps switching of general purposed receptacle (plug-load) control.
- 17. Power (Relay) Packs and Supplies shall be the following nLight model numbers: nPP16 (Power Pack w/ 16A relay) nPP16 D (Power Pack w/ 16A relay and 0-10VDC dimming output) nPP16 WIFI (Power Pack w/ 16A relay, WIFI enabled) nEPP5 D (Power Pack w/ 5A relay and 0-10VDC dimming output) nSP16 (Secondary Pack w/ 16A relay) nPP16 ER (UL924 Listed Secondary Pack w/ 16A relay for switching emergency power circuits) nPP16 D ER UL924 Listed Secondary Pack w/ 16A relay and 0-10VDC dimming output for switching/dimming emergency power circuits) nSP5 PCD 2W (Secondary Pack w/ 5A relay and incandescent dimming or 2-wire line voltage fluorescent dimming output) nSP5 PCD 3W (Secondary Pack w/ 5A relay and 3-wire line voltage fluorescent dimming output) nSP5 PCD MLV (Secondary Pack w/ 5A relay and magnetic low voltage dimming output) nSP5 PCD ELV 120 (Secondary Pack w/ 4A relay and electronic low voltage dimming output) nSP5 2P LVR (Louver/Damper Control Pack nSHADE (Pulse On/Off Control Pack nPP20 PL (Secondary Pack w/ 20A relay for general purpose receptacle load) nPS 80 (Auxiliary Bus Power Supply) nPS 80 WIFI (Auxiliary Bus Power Supply, WiFi enabled) nAR 40 (Low voltage auxiliary relay pack)

- E. Networked System Relay & Dimming Panels
 - 1. Panel shall incorporate up to 4 normally closed latching relays capable of switching 120/277 VAC or up to 2 Dual Phase relays capable of switching 208/240/480 VAC loads.
 - 2. Relays shall be rated to switch up to a 30A ballast load at 277 VAC.
 - 3. Panel shall provide one 0-10VDC dimming output paired with each relay.
 - 4. Panel shall power itself from an integrated 120/277 VAC supply.
 - 5. Panel shall be capable of operating as either two networked devices or as one.
 - 6. Panel shall supply current limited low voltage power to other networked devices connected via CAT-5.
 - 7. Panel shall provide auxiliary low voltage device power connected wired directly to a dedicated terminal connection.
 - Power (Relay) Packs and Supplies shall be the following nLight model numbers: nPANEL 4 (Panel w/ four 120/277 VAC relays and four 0-10 VDC dimming outputs) nPANEL 2 480 (Panel w/ two dual phase relays (208/240/480 VAC) and two 0-10 VDC dimming outputs)
- F. Networked Auxiliary Input / Output (I/O) Devices
 - Devices shall be plenum rated and be inline wired, screw mountable, or have an extended chase nipple for mounting to a ¹/₂" knockout.
 - 2. Devices shall have two RJ-45 ports
 - 3. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
 - 4. Specific I/O devices shall have a dimming control output that can control 0-10 VDC dimmable ballasts or LED drivers by sinking up to 20 mA of current.
 - 5. Specific I/O devices shall have an input that reads a 0-10 VDC signal from an external device.
 - 6. Specific I/O devices shall have a switch input that can interface with either a maintained or momentary switch and run a switch event (toggle the lighting load) or run a local/remote control profile.
 - 7. Specific I/O devices shall sense state of low voltage outdoor photocells.
 - 8. Specific I/O devices shall enable RS-232 communication between lighting control system and Touch Screen based A/V control systems.
 - 9. Specific I/O devices shall sense momentary and maintained contact closures, and either toggle a connected load after a momentary contact or ramp the load high/low during a maintained contact (stopping when the contact releases).
 - 10. Auxiliary Input/Output Devices shall be the following nLight model numbers:
 - nIO D (I/O device with 0-10 dimming output) nIO 1S or nIO RLX (I/O device with contact closure or 0-10VDC dimming
 - input)
 - nIO NLI (Input device for detecting state of low voltage outdoor photocell; sold in nIO PC KIT only)

nIO X (Interface device for communicating with RS-232 enabled AV Touch

Screens

- G. Networked LED Luminaires
 - 1. Networked LED luminaire shall have a mechanically integrated control device

- 2. Networked LED luminaire shall have two RJ-45 ports available (via control device directly or incorporated RJ-45 splitter)
- 3. Networked LED luminaire shall be able to digitally network directly to other network control devices (sensors, photocells, switches, dimmers)
- 4. Networked LED luminaire shall provide low voltage power to other networked control devices (excluding EMG versions)
- 5. System shall be able to turn on/off specific LED luminaires without using a relay, if LED driver supports "sleep mode"
- 6. System shall be able to maintain constant lumen output over the specified life of the LED luminaire (also called lumen compensation) by varying the input control power (and thus saving up to 20% power usage).
- 7. System shall indicate (via a blink warning) when the LED luminaire has reached its expected life (in hrs).
- 8. Integrated control devices shall be the following nLight model series:

nIO LEDG (ER) nIO EZ PH (ER) nPS 80 EZ (ER) nEPS 60 IO EZ nEIO EZ LC (ER)

9. LED Luminaires shall be the following Acuity Brands LED fixtures, which come factory enabled with nLight devices:

Lithonia model families:

RTL(X) TL(X) VTL(X) FSL(X) ACL(X) ALL(S) AVL BZL GTL SBS IBL/IBH PTN LDN DOM WL STL Gotham model families: EVO Incito Mark model families: Slot 2/4/6 Fin Veil Whisper Nol

SPR

Peerless model families: Vellum Mino Round 2/4 Square Origami Bruno Staple Lightline Lightedge Icetray Cerra Prima Naro Tulip Envision Aero Enzo

- H. Networked System Wall Switches & Dimmers
 - 1. Devices shall recess into single-gang switch box and fit a standard GFI opening.
 - 2. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
 - 3. All devices shall have two RJ-45 ports.
 - 4. All devices shall provide toggle switch control. Dimming control and low temperature/high humidity operation are available options.
 - 5. Devices shall be available in four colors (Ivory, White, Light Almond, Gray).
 - 6. Devices with mechanical push-buttons shall provide tactile and LED user feedback.
 - 7. Devices with mechanical push-buttons shall be made available with custom button labeling
 - 8. Devices with a single "on" button shall be capable of selecting all possible lighting combinations for a bi-level lighting zone such that the user confusion as to which of two buttons (as is present in multi-button scenarios) controls which load is eliminated.
 - 9. Wall switches & dimmers shall be the following nLight model numbers, with device options as specified:

nPODM (single on/off, push-buttons, LED user feedback)

nPODM DX (single on/off, single dimming raise/lower, push-buttons, LED user feedback)

nPODM 2P (dual on/off, push-buttons, LED user feedback)

nPODM 2P DX (dual on/off, dual dimming raise/lower, push-buttons, LED user feedback)

nPODM 4P (quad on/off, push-buttons, LED user feedback) nPODM 4P DX (quad on/off, quad dimming raise-lower, push-buttons, LED user feedback)

I. Networked System Graphic Wall Station

- 1. Device shall have a 3.5" full color touch screen for selecting up to 16 programmable lighting control preset scenes or acting as up to 16 on/off/dim control switches.
- 2. Devices shall be available in four colors (Ivory, White, Light Almond, Gray).
- 3. Device shall enable configuration of all switches, dimmers, and lighting preset scenes via password protected setup screens.
- 4. Device shall enable user supplied .jpg screen saver image to be uploaded.
- 5. Device shall surface mount to single-gang switch box.
- 6. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply.
- 7. Device shall have a micro-USB style connector for local computer connectivity.
- 8. Device shall have two RJ-45 ports for communication
- 9. Device shall be the following nLight model number: nPOD GFX
- J. Networked System Scene Controllers
 - 1. Device shall have two, three, four, or eight buttons for selecting programmable lighting control profiles or acting as on/off switches.
 - 2. Devices shall be available in four colors (Ivory, White, Light Almond, Gray).
 - 3. Device shall recess into single-gang switch box and fit a standard GFI opening.
 - 4. Devices shall provide LED user feedback.
 - 5. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
 - 6. All devices shall have two RJ-45 ports.
 - 7. Device shall be capable of reprogramming other devices in its zone so as to implement user selected lighting scene.
 - 8. Device shall be capable of selecting a lighting profile be run by the system's upstream Gateway so as to implement selected lighting profile across multiple zones (and not just its local zone).
 - 9. Device shall have LEDs indicating current selection.
 - 10. Scene Selector device shall be the following nLight model number:

nPODM 2S (2 Scene, push-button) nPODM 4S (4 Scene, push-button) nPODM 4S DX (4 Scene, push-button, On/Off/Raise/Lower) nPODM 2L (2 Adjustable Preset Levels, push-button, On/Off) nPODM 2L AB (2 Scene, push-button, On/Off/High/Low) nPODM 4L DX (4 Adjustable Preset Levels, push-button, On/Off/Raise/Lower)

- K. Communication Bridges
 - 1. Device shall surface mount to a standard 4" x 4" square junction box.
 - 2. Device shall have 8 RJ-45 ports.
 - 3. Device shall be capable of aggregating communication from multiple lighting control zones for purposes of minimizing backbone wiring requirements back to Control Gateway.
 - 4. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply or delivered via a CAT-5 cabled connection.
 - 5. Device shall be capable of redistributing power from its local supply and connect lighting control zones with excess power to lighting control zones with insufficient local power.

Lighting Control System

This architecture also enables loss of power to a particular area to be less impactful on network lighting control system.

6. Communication Bridge devices shall be the following nLight model numbers: nBRG 8 (8 Ports)

2.4. LIGHTING CONTROL PROFILES

- A. Changes to the operation of the system shall be capable of being made in real-time or scheduled via lighting control profiles. These profiles are outlines of settings that direct how a collection of devices function for a defined time period.
- B. Lighting control profiles shall be capable of being created and applied to a single device, zone of devices, or customized group of zones.
- C. All relays and dimming outputs shall be capable of being scheduled to track or ignore information regarding occupancy, daylight, and local user switches via lighting control profiles.
- D. Specific device parameters (e.g. sensor time delay and photocell set-point) shall be configurable via a lighting control profile.
- E. All lighting control profiles shall be stored on the network control gateway device, with a system backup on the software's host server.
- F. Lighting control profiles shall be capable of being scheduled to run according to the following calendar options: start date/hour/minute, end date/hour/minute, and sunrise/sunset +/- timed offsets.
- G. Sunrise/sunset times shall be automatically derived from location information using an astronomical clock.
- H. Daylight savings time adjustments shall be capable of being performed automatically, if desired.
- I. Lighting control profile schedules shall be capable of being given the following recurrence settings: daily, weekday, weekend, weekly, monthly, and yearly.
- J. Software shall provide a graphical tool for easily viewing scheduled lighting control profiles.

2.5. MANAGEMENT SOFTWARE

- A. Every device parameter (e.g. sensor time delay and photocell set-point) shall be available and configurable remotely from the software
- B. The following status monitoring information shall be made available from the software for all devices for which it is applicable: current occupancy status, current PIR Status, current Microphonics Status, remaining occupancy time delay(s), current photocell reading, current photocell inhibiting state, photocell transitions time remaining, current dim level, device temperature, and device relay state(s).
- C. The following device identification information shall be made available from the software: model number, model description, serial number, manufacturing date code, custom label(s), and parent network device.
- D. A printable network inventory report shall be available via the software.
- E. A printable report detailing all system profiles shall be available via the software.
- F. Software shall require all users to login with a User Name and Password.
- G. Software shall provide at least three permission levels for users.
- H. All sensitive stored information and privileged communication by the software shall be encrypted.
- I. All device firmware and system software updates must be available for automatic download and installation via the internet.
- J. Software shall be capable of managing systems interconnected via a WAN (wide area network)

2.6. BMS COMPATIBILITY

Lighting Control System

- A. System shall provide a BACnet IP gateway as a downloadable software plug-in to its management software.
- B. BACnet IP connection shall also be available utilizing JACE-600 hardware unit.
- C. BACnet IP hardware shall be capable of supporting up to 1500 total devices across up to 5 total Gateways
- D. BACnet IP connection shall communicate information gathered by networked system to other building management systems.
- E. BACnet IP connection shall translate and forward lighting relay and other select control commands from BMS system to networked control devices via profiles stored in the system Gateway. All system devices shall be available for polling for devices status.
- F. BACnet IP hardware device shall be the following nLight model name: nBACnet

2.7. SYSTEM ENERGY ANALYSIS & REPORTING SOFTWARE

- A. System shall be capable of reporting lighting system events and performance data back to the management software for display and analysis.
- B. Intuitive graphical screens shall be displayed in order to facilitate simple viewing of system energy performance.
- C. An "Energy Scorecard" shall be display that shows calculated energy savings in dollars, KWHr, or CO2.
- D. Software shall calculate the allocation of energy savings to different control measures (occupancy sensors, photocells, manual switching, etc).
- E. Energy savings data shall be calculated for the system as a whole or for individual zones.
- F. A time scaled graph showing all relay transitions shall be presented.
- G. A time scaled graph showing a zones occupancy time delay shall be presented
- H. A time scaled graph showing the total light level shall be presented.
- I. User shall be able to customize the baseline run-time hours for a space.
- J. User shall be able to customize up to four time-of-day billing rates and schedules.
- K. Data shall be made available via a .CSV file

2.8. START-UP & SUPPORT FEATURES

- A. Pre-construction Jobsite Visit
 - a. Project electrical contractor/distributor shall contact Spectrum Lighting San Antonio to schedule jobsite meeting prior to the beginning of the installation of the lighting control system. Purpose of the meeting is to review installation documentation provided by the system manufacturer and submittals. Discussion should include wiring conventions and specific wiring requirements. Installation of specific devices are also to be addressed.
 - b. Purpose is to review any questions regarding the installation of the lighting control system by the installing contractor.
 - c. Prior to commissioning Spectrum Lighting field service technical shall visit the jobsite to confirm progress and answer any additional questions. Commissioning date is to be confirmed at the time of this visit. Training agenda shall be provided to the contractor/distributor. Contractor/distributor shall confirm owner representative and specifying engineer attendance at lighting system demonstration and/or for training. Contractor/distributor shall provide to filed service technician programming information as required for commissioning to include zone assignments, time schedules for operation,

presets for all control stations, programming sequences for dynamic LED fixtures, emergency operation, blink warn, and system override. Programming information is required for system set-up and pre-commissioning.

- B. Lighting Control System Commissioning and Training
 - a. Prior to energizing the lighting control system, the following must be completed: No component of the lighting control system shall be energized prior to a factory certified field service engineer has approved the installation of the system by the project electrical contractor. Failure to have a factory certified field service technician approve the installation and commission the system will relieve the manufacturer of the lighting control equipment of all responsibility relating to damaged parts or warranty. The electrical contractor/distributor shall contact Spectrum Lighting at least 3 weeks prior to the requested commissioning date to schedule a field service engineer to be at the jobsite. Request shall be in writing and shall include filled out commissioning request form and dated jobsite photos of the dimmer and/or relay panels.
 - b. Lighting Control system is defined as the dimmer/relay panel(s) and all associated control stations and related accessories.
 - c. The electrical contractor is responsible to install the entire lighting control system, all power feeders, all load wiring, and control wiring. Equipment shall be installed according to the manufacturer's instructions, contract documents, and national and local codes and regulations.
 - d. Equipment shall be plumb and level to the finished floor. All components of the lighting control system shall be clean, free of dust and paint spatters. Components shall be unmarred or damaged. All cable shall be dressed, neatly routed, and labeled. All conduit shall be securely attached to the dimmer/relay panel.
- C. Commissioning
 - a. Each dimmer/relay panels shall be individually tested with the connected load as designed. Each dimmer/relay should be tested with its connected load as specified.
 - b. Each dimmer/relay shall be tested by the electrical contractor (with a multi-meter) to confirm what voltage is being passed and to confirm that no voltage is being passed when the circuit is open.
 - c. A representative of the owner shall be present to observe the testing/demonstration of the dimmer/relay panels. Each individual dimmer/relay panel shall be load tested with all circuits on while under load for a minimum of 1 hour.
 - d. Where external devices are to be attached to the dimmer/relay panel including photocell, occupancy sensor, time clock, and/or control stations, operation of each device should be verified at the panel and specific circuits that are programmed to be controlled by the external device(s).
 - e. Where control signals originate from the dimmer/relay panel for control of lighting fixtures, the control signal shall be tested by the electrical contractor to confirm that it is being delivered to each lighting fixture. Proper operation of the lighting fixtures shall be confirmed as part of the system testing/demonstration.

D. Training

a. Training shall be provided for the owner's representative and contractor FOR A TOTAL OF 8-HOURS. Prior to commissioning owner's representative and electrical contractor/distributor shall acknowledge receipt of training agenda. Electrical contractor/distributor shall confirm that specifying engineer has been contacted and been invited to attend the system demonstration and/or training. All product and lighting control system documentation and operation's manuals shall be provided by electrical contractor/distributor at the time of training.

- b. Training is to include, but not be limited to: basic operation of lighting control system, set-up of system and control panels, operation of control stations, programming of system, basic be-bugging, and overall system testing. At completion of training session all in attendance shall sign the commissioning technician's field service report to confirm participation in the training session.
- c. Completed field service report shall be submitted to the electrical contractor/distributor and specifying engineer.
- E. Follow-up Contact
 - a. Approximately 90 days following the commissioning of the lighting control system Spectrum Lighting shall contact the electrical contractor/distributor to confirm that the system is operating correctly and answer any operational questions that have come-up since commissioning.
- F. Warranty Review and Follow-up Visit
 - a. Approximately 300 days following commissioning of the lighting control system Spectrum Lighting shall contact the owner's representative who attended the system demonstration and training and electrical contractor/distributor to schedule a visit to the jobsite. Visit shall be scheduled so that testing of the lighting control system and related equipment can be conducted without disturbing normal operation of the jobsite. In attendance should be owner's representative and contractor.
 - b. The lighting control system shall be demonstrated to confirm operation. All system programming shall be confirmed and when necessary adjusted to meet the set-up or current requirements. When programming needs to be adjusted the new system configuration files shall be forwarded by the field service technician to the system manufacturer, as required. Copies can be provided to owner's representative upon request. Any questions regarding operation of the system shall be addressed at this time.
 - c. Any lighting control equipment that is not operating as defined by the specification shall be repaired or replaced at the discretion of the field service technician. Projected dates for completion of all changes will be included in the follow-up report. All system changes and updates shall be documented by the field service technician and provided in a written report to the owner's representative, contractor, and specifying engineer.
 - d. To facilitate start-up, all devices daisy-chained together (using CAT-5) shall automatically be grouped together into a functional lighting control zone.
 - e. All lighting control zones shall be able to function according to default settings once adequate power is applied and before any system software is installed.
 - f. Once software is installed, system shall be able to auto-discover all system devices without requiring any further programming.
 - g. All system devices shall be capable of being given user defined names.
 - h. All devices within the network shall be able to have their firmware upgraded remotely and without being physically uninstalled for purposes of upgrading functionality at a later date.
 - i. All sensor devices shall have the ability to detect improper communication wiring and blink it's LED in a specific cadence as to alert installation/startup personnel.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes load centers and panelboards, overcurrent protective devices, and associated auxiliary equipment rated 600 V and less for the following types:
 - 1. Edit panelboards below to suit Project.
 - 2. Lighting and appliance branch-circuit panelboards.
 - 3. Distribution panelboards.
- B. Related Sections include the following:
 - 1. List below only products, construction, and equipment that the reader might expect to find in this Section but are specified elsewhere.
 - 2. Retain subparagraph below if Project includes fusible panelboards.
 - 3. Section "Fuses."

1.3 **DEFINITIONS**

- A. Retain abbreviations that remain after this Section has been edited.
- B. EMI: Electromagnetic interference.
- C. GFCI: Ground-fault circuit interrupter.
- D. RFI: Radio-frequency interference.
- E. RMS: Root mean square.
- F. SPDT: Single pole, double throw.
- G. TVSS: Transient voltage surge suppressor.
- 1.4 SUBMITTALS
 - A. Product Data: For each type of panelboard, overcurrent protective device, TVSS device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
 - B. Shop Drawings: For each panelboard and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Bus configuration, current, and voltage ratings.
 - c. Short-circuit current rating of panelboards and overcurrent protective devices.
 - d. Delete subparagraph below if series rating of overcurrent protective devices is not used.
 - e. UL listing for series rating of installed devices.

- f. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- 2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.
- C. Delete paragraph below if independent testing agency is not used.
- D. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in "Quality Assurance" Article.
- E. Field Test Reports: Submit written test reports and include the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- F. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- G. Maintenance Data: For panelboards and components to include in maintenance manuals specified in other sections. In addition to requirements specified in Section "Contract Closeout," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

- A. Retain paragraph and subparagraph below if Contractor or manufacturer selects testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.

1.6 COORDINATION

- A. Edit below to delete or add types of equipment that affect panelboard installation.
- B. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.
- 1.7 EXTRA MATERIALS
 - A. Extra materials may not be allowed for publicly funded projects. Revise quantity below to suit Project.
 - B. Keys: [SIX] 6 spares of each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Retain above for nonproprietary or below for semiproprietary Specification. Refer to Division 1 Section "Materials and Equipment."
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Lists below are examples only. Retain or insert only those manufacturers whose products correspond with other requirements and whose availability and suitability for the application have been verified.
 - 2. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
 - a. Eaton
 - b. Square D Co.
 - c. General Electric
 - d. Siemens

2.2 FABRICATION AND FEATURES

- A. Enclosures: Flush- and surface-mounted cabinets. NEMA PB 1, Type 1, to meet environmental conditions at installed location.
 - 1. Outdoor Locations: NEMA 250, Type 3R.
 - 2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - 3. Enclosures in hazardous locations must be carefully selected to meet the division and group listing of the environment.
 - 4. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.
- B. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
- C. Retain paragraph above or below.
- D. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
- E. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
- F. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.
- G. Bus: Hard-drawn copper, 98 percent conductivity.
- H. Main and Neutral Lugs: Copper mechanical type suitable for use with conductor material.
- I. Ten paragraphs below are special features. Add other required features and coordinate with Drawings.
- J. Equipment Ground Bus: Copper and adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
- K. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.
- L. Isolated Equipment Ground Bus: Copper and adequate for branch-circuit equipment ground conductors; insulated from box.
- M. Extra-Capacity Neutral Bus: Copper neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
- N. Split Bus: Vertical buses divided into individual vertical sections.
- O. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
- P. Gutter Barrier: Arrange to isolate individual panel sections.
- Q. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.
- R. Feed-through Lugs: Copper mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
- 2.3 PANELBOARD SHORT-CIRCUIT RATING
 - A. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Branch Overcurrent Protective Devices: Plug-in or bolt on circuit breakers, replaceable without disturbing adjacent units.
- B. Coordinate below with Drawings.
- C. Doors: Front mounted with concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 DISTRIBUTION PANELBOARDS

- A. Edit three paragraphs and associated subparagraphs below to suit Project. Coordinate with Drawings.
- B. Doors: Front mounted, except omit in fused-switch panelboards; secured with vault-type latch with tumbler lock; keyed alike.
- C. Main Overcurrent Protective Devices: Circuit breaker.

- D. Branch overcurrent protective devices shall be one of the following:
 - 1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in or Bolt-on circuit breakers.
 - 2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.6 OVERCURRENT PROTECTIVE DEVICES

- A. Edit three paragraphs and associated subparagraphs below to suit Project. Coordinate with schedules and Drawings.
- B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following fieldadjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I²t response.
 - 3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 - 4. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
 - 5. GFCI Circuit Breakers: Single- and two-pole configurations with [5] [30]-mA trip sensitivity.
- C. Molded-Case Circuit-Breaker Features and Accessories. Standard frame sizes, trip ratings, and number of poles.
 - 1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.
 - 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 - 3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

D. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Mounting Heights: Top of trim 74 inches (1880 mm) above finished floor, unless otherwise indicated.
- C. Mounting: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
- D. Revise paragraph below if "Balancing Loads" Paragraph is deleted from "Field Quality Control" Article below.
- E. Circuit Directory: Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- F. Install filler plates in unused spaces.
- G. Revise below if "Balancing Loads" Paragraph is deleted from "Field Quality Control" Article below.
- H. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.
- 3.2 IDENTIFICATION
 - A. Select Division 16 Section "Basic Electrical Materials and Methods" for projects with simple requirements and Division 16 Section "Electrical Identification" for projects with complex requirements.

- B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section "Basic Electrical Materials and Methods] [Electrical Identification."
- C. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS

- A. Coordinate paragraphs below with Drawings.
- B. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Balancing Loads: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes as follows:
 - 1. Measure as directed during period of normal system loading.
 - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data-processing, computing, transmitting, and receiving equipment.
 - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.5 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.
- 3.6 CLEANING
 - A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.
- 1.2 SUMMARY
 - A. This Section includes receptacles, connectors, switches, and finish plates.
- 1.3 DEFINITIONS
 - A. Retain abbreviations that remain after this Section has been edited for Project.
 - B. GFI: Ground-fault circuit interrupter.
 - C. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS

- A. Product Data: For each product specified.
- B. Shop Drawings: Legends for receptacles and switch plates.
- C. Include sample review below if products may have critical features needing hands-on appraisal.
- D. Samples: For devices and device plates for color selection and evaluation of technical features.
- E. Maintenance Data: For materials and products to include in maintenance manuals specified in other sections.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- B. Comply with NEMA WD 1.
- C. Comply with NFPA 70.
- 1.6 COORDINATION
 - A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - B. Coordinate with pool contractor for special receptacles.

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS
 - A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Wiring Devices:
 - a. Bryant Electric, Inc.
 - b. Eagle Electric Manufacturing Co., Inc.
 - c. GE Company; GE Wiring Devices.
 - d. Hubbell, Inc.; Wiring Devices Div.
 - e. Killark Electric Manufacturing Co.
 - f. Leviton Manufacturing Co., Inc.
 - g. Pass & Seymour/Legrand; Wiring Devices Div.
 - h. Pyle-National, Inc.; an Amphenol Co.
- 2.2 RECEPTACLES
 - A. Straight-Blade and Locking Receptacles: Heavy-Duty grade. The device shall be 20-ampere, 125-volts, Nema configuration 5-20R, back and side wired.
 - B. Special Receptacles for NEMA configuration refer to Manufacturer specs.

- C. Termination-type GFCI unit may be substituted for feed-through type where no protection of downstream receptacles is required.
- D. GFI Receptacles: Feed-through type, with integral NEMA WD 6, Configuration 5-20R duplex receptacle arranged to protect connected downstream receptacles on same circuit. Design units for installation in a 2-3/4-inch- (70-mm-) deep outlet box without an adapter. Device shall have an indicator light.
- E. Isolated-Ground Receptacles: Equipment grounding contacts connected only to the green grounding screw terminal of the device with inherent electrical isolation from mounting strap. Device shall be white finish with the orange symbol.
 - 2. Devices: Listed and labeled as solated-ground receptacles.
 - 3. Isolation Method: Integral to receptacle construction and not dependent on removable parts.

2.3 SWITCHES

- A. General
 - 1. Switches shall be toggle rocker type as indicated herein.. The body of the switch shall be made of an arc-resistant thermoset material. All toggle switch handles shall be constructed of a thermoplastic material. All rocker switch handles shall be constructed of a thermoset material. All wall switches shall be of the quiet AC type.
 - 2. Switches shall be SPST, DPST, 3-way or 4-way as indicated on the Drawings.
 - 3. Switch color shall be white unless noted otherwise. Coordinate with Architect.
- B. Specification Grade
 - 1. Specification Grade switches shall be toggle type. The contact arms shall be made of one-piece copper alloy material. The switch shall include a green ground screw attached to the mounting strap. The switch shall be 20-ampere, 120/277-volts AC, horsepower rated, back and side-wired.
- C. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible and electromagnetic noise filters.
 - 2. Control: Continuously adjustable slide, toggle, or rotary knob. Single-pole or three-way switch to suit connections.
 - 3. Incandescent Lamp Dimmers: Modular, 120 V, 60 Hz with continuously adjustable slide with "on/off" switch; single pole with soft tap or other quiet switch; electromagnetic filter to eliminate noise, RF, and TV interference; and 5-inch (130-mm) wire connecting leads. Dimmer to be sized per circuit load.
- 2.4 WALL PLATES(All wall plates)
 - A. For all single and combination types match corresponding wiring devices.
 - 4. Plate-Securing Screws: Metal with head color to match plate finish.
 - 5. Material for Finished Spaces: 0.04-inch- (1-mm-) thick, Type 302, satin-finished stainless steel.
 - 6. Material for Unfinished Spaces: stainless steel.

2.5 FLOOR SERVICE FITTINGS

- A. Power Receptacle: NEMA WD 6, Configuration 5-20R, gray finish, unless otherwise indicated.
- B. Signal Outlet: Blank cover with bushed cable opening, unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install devices and assemblies plumb and secure.
- B. Install wall plates when painting is complete.
- C. Install wall dimmers to achieve indicated rating after derating for ganging as instructed by manufacturer.
- D. Do not share neutral conductor on load side of dimmers.
- E. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- F. Protect devices and assemblies during painting.
- G. Adjust locations at which floor service outlets and telephone/power service poles are installed to suit arrangement of partitions and furnishings.
H.

3.2 IDENTIFICATION

- A. Comply with Section "Electrical Identification."
- B. Comply with Section "Basic Electrical Materials and Methods."
 - 1. Switches: Where three or more switches are ganged, and elsewhere as indicated, identify each switch with approved legend engraved on wall plate.
 - 2. Receptacles: Identify panelboard and circuit number from which served. Use machine-printed, pressuresensitive, abrasion-resistant label tape on face of plate and durable wire markers or tags within outlet boxes.

3.3 CONNECTIONS

- A. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.
- B. Isolated-Ground Receptacles: Connect to isolated-ground conductor routed to designated isolated equipment ground terminal of electrical system.
- C. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values. If manufacturers torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

- A. Test wiring devices for proper polarity and ground continuity. Operate each device at least six times.
- B. Dparagraph below if GFCIs are not in Part 2.
- C. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.
- D. Replace damaged or defective components.

3.5 CLEANING

A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

SECTION 26 28 13

FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Fuses.

1.3 SUBMITTALS

- A. Use this Article to convey basic design intent. Delete if Drawings show sufficient detail to clarify intent.
- B. General: Submit each item in this Article according to the Conditions of the Contract and Specification Sections.
- C. Product Data for each fuse type specified.
- D. Select above or below. Data listed in paragraph below are appropriate where selective coordination is necessary.
- E. Field test reports indicating and interpreting test results.
- F. Maintenance data for tripping devices to include in the operation and maintenance manual specified in other sections.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses from one source and by a single manufacturer.
- B. Comply with NFPA 70 for components and installation.
- C. Listing and Labeling: Provide fuses specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
 - 2. Subparagraph below is required by some Federal agencies.
 - 3. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

1.5 EXTRA MATERIALS

- A. Extra materials may not be allowed for publicly funded projects.
- B. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
- 1. Spare Fuses: Furnish quantity equal to 20 percent of each fuse type and size installed, but not less than 1 set of 3 of each type and size.

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS
 - A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering fuses that may be incorporated into the Work include, but are not limited to, the following:
 - B. Retain above for nonproprietary or below for semiproprietary Specification. Refer to Division 1 Section "Materials and Equipment."
 - C. Manufacturers: Subject to compliance with requirements, provide fuses by one of the following:

- 1. See Editing Instruction No. 1 in the Evaluations for cautions about naming products and manufacturers.
- 2. Cooper Industries, Inc.; Bussmann Div.
- 3. Eagle Electric Mfg. Co., Inc.
- 4. Ferraz Corp.
- 5. General Electric Co.; Wiring Devices Div.
- 6. Gould Shawmut.
- 7. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class as specified or indicated; current rating as indicated; voltage rating consistent with circuit voltage.

2.3 SPARE FUSE CABINET

- A. Cabinet: Wall-mounted, 0.05-inch- (1.27-mm-) thick steel unit with full-length, recessed piano-hinged door with key-coded cam lock and pull.
 - 1. Size: Adequate for orderly storage of spare fuses specified with 15 percent spare capacity minimum.
 - 2. Finish: Gray, baked enamel.
 - 3. Identification: Stencil legend "SPARE FUSES" in 1-1/2-inch (40-mm) letters on door.
 - 4. Fuse Pullers: For each size fuse.

PART 3 - EXECUTION

- 3.1 EXAMINATION
 - A. Examine utilization equipment nameplates and installation instructions to verify proper fuse locations, sizes, and characteristics.
 - B. Do not proceed with installation until unsatisfactory conditions have been corrected.
- 3.2 FUSE APPLICATIONS
 - A. Select and edit paragraphs below. Add paragraphs as Project requires to specify fuse applications rather than show them on Drawings.
 - B. Motor Branch Circuits: Class RK1, time delay.
 - C. Other Branch Circuits: Class RK5, non-time delay.
- 3.3 INSTALLATION
 - A. Install fuses in fusible devices as indicated. Arrange fuses so fuse ratings are readable without removing fuse.
 - B. Install spare fuse cabinet where indicated.
- 3.4 IDENTIFICATION
 - A. Install typewritten labels on inside door of each fused switch to indicate fuse replacement information.

SECTION 26 28 16.16

ENCLOSED SWITCHES

PART 1 - GENERAL

- 1.1 RELATED REQUIREMENTS
 - A. The General Provisions, Supplemental General Provisions, Special Provisions and Specification sections, apply to work covered by this Section.
- 1.2 SCOPE OF WORK
 - A. Provide labor, materials, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of disconnect switches, including all related systems and accessories.
- 1.3 SUBMITTALS
 - A. Submit product data and shop drawings in accordance with other Sections for products specified under PART 2 PRODUCTS.
 - B. Provide outline drawings with dimensions, and equipment ratings for voltage, amperage, horsepower and short circuit.
 - C. Provide designations for each disconnect. RE: to section 16075.
- 1.4 REFERENCE STANDARDS
 - A. Switches shall be manufactured in accordance with the following standards:
 - 1. UL 98 Enclosed and Dead Front Switches
 - 2. NEMA KS1 Enclosed Switches
 - 3. NEMA 250 Enclosures for Electrical Equipment

PART 2 - PRODUCTS

- 2.1 MANUFACTURER
 - A. Eaton
 - B. Square D Co.
 - C. General Electric
 - D. Siemens

2.2 GENERAL

- A. Switches shall be heavy duty type.
- 2.3 SWITCH INTERIOR
 - A. Switches shall have switch blades which are visible when the switch is OFF and the cover is open.
 - D. Lugs shall be copper and front removable and UL listed for 60°C or 75°C conductors 30-100 ampere, 75°C conductors 200 ampere and up.
 - E. Current carrying parts shall be plated to resist corrosion.
 - F. Switches shall have removable arc suppressor to facilitate easy access to line side lugs.
 - G. Switches shall have provisions for a field installable electrical interlock.

2.4 SWITCH MECHANISM

- A. Switch operating mechanism shall be quick-make, quick-break such that, during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started.
- B. The operating handle shall be an integral part of the box, not the cover.
- C. Provisions for padlocking the switch in the OFF position with at least three padlocks shall be provided.
- D. The handle position shall travel at least 90° between OFF and ON positions to clearly distinguish and indicate handle position.
- E. Switches shall have a dual cover interlock mechanism to prevent unintentional opening of the switch cover when the switch is ON and prevent turning the switch ON when the cover is open. The cover interlock mechanism shall have an externally operated override but the override shall not permanently disable the interlock mechanism. The tool

used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

- 2.5 SWITCH ENCLOSURES
 - A. Switch covers shall be attached with welded pin-type hinges (Type 1) or top-hinged, attached with removable screws and securable in the open position (Type 3R).
 - B. The enclosure shall be finished with gray baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated steel (Type 1) or gray baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated galvannealed steel (Type 3R).
 - C. The enclosure shall have ON and OFF markings stamped into the cover.
 - D. The operating handle shall be provided with a dual colored, red/black position indication.
 - E. Switches shall have provisions to accept up to three 3/8" hasp padlocks to lock the operating handle in the OFF position.
 - H. Tangential knockouts shall be provided to facilitate ease of conduit entry (Type 1).
 - I. Type 3R enclosure shall contain no knockouts. Supply watertight hubs.
 - J. Type 4x shall be stainless steel enclosure with no knockouts. Supply watertight hubs.

2.6 SWITCH RATINGS

- A. Switches shall be horsepower rated.
- B. The UL listed short circuit current rating of the switches shall be: 200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses 30-600 ampere employing appropriate fuse rejection schemes.

PART 3- EXECUTION

- 3.1 INSTALLATION
 - E. Install disconnect switches where indicated shown or not shown.
 - F. Install fuses in fusible disconnect switches.

SECTION 26 43 13

SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. The General Provisions, Supplemental General Provisions, Special Provisions, apply to work covered by this Section.
- B. Comply with Electrical Sections, as applicable. Refer to other Sections for coordination of work.

1.2 SCOPE OF WORK

- A. Provide labor, material, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of a high-energy power conditioning surge protection device(s) at branch circuit panelboards where indicated on the Drawings. The device shall incorporate transient voltage surge suppression (TVSS) and high-frequency electrical line noise filtering. The device shall provide effective high energy transient voltage suppression, surge current diversion, high-frequency attenuation, and line stabilization in ANSI/IEEE C62.41-2002 environments connected downstream from the facility's main overcurrent protective device. The device shall be connected in parallel with the facility's wiring system.
- B. The device shall be installed as an integral part or external of the panelboard, switchboard.

1.3 SUBMITTALS

- A. Submit product data and shop drawings for products specified under PART 2 PRODUCTS.
- B. Manufacturers' Product Data: Submit material specifications and installation data for products specified under PART 2 PRODUCTS.

C.

- D. Shop Drawings: Submit shop drawings to indicate information not fully described by the product data to indicate compliance with the contract documents.
 - 1 Include electrical characteristics and ratings for the specified equipment.
 - 2 Include wiring diagrams indicating the internal connections of the specified equipment within its enclosure.
 - 3 Drawings shall be provided indicating device dimensions, weights, mounting provisions, connection details and wiring diagrams.
 - 4 Documentation of the specified device UL 1449 3rd Edition voltage protection rating (VPR) and per mode surge current rating shall be included. All submittals without this documentation will be rejected.
 - 5 The manufacturer shall make available upon request certified documentation of applicable Location Category Testing in full compliance with ANSI/IEEE C62.41-1991 and ANSI/IEEE C62.45-1987 Guidelines.
- E. Record Drawings
 - 1 A complete set of manufacturers' product data and shop drawings indicating all post bid revisions and field changes.

1.4 QUALITY ASSURANCE

- A. Industry Reference Standards and Publications: The device shall be designed, manufactured, tested and installed in compliance with the latest editions of:
 - 1 American National Standards Institute (ANSI) and Institute of Electrical and Electronic Engineers (ANSI/IEEE C62.41-2002 and C62.45-2002)
 - 2 Federal Information Processing Standards Publication 94 (FIPS PUB 94)
 - 3 National Electrical Manufacturers Association (NEMA LS-1)
 - 4 National Fire Protection Association (NFPA 70, National Electrical Code (NEC), 75 and 78)
 - 5 Underwriters Laboratories UL 1449 Standard for Transient Voltage Surge Suppressors Surge Protection Devices and UL 1283 Standard for Electromagnetic Interference Filters.
- B. The device shall be UL listed under UL 1449 and UL 1283 complimentary listed.
- C. The device shall be warranted against defects in material and/or workmanship and any failure or end-of-life event including lighting for a minimum of TEN (10) years from the date of shipment.

D.

E. The device shall be thoroughly factory-tested before shipment. Testing of the device shall include but not be limited to quality control checks, maximum continuous operating voltage (MCOV) check, and clamping voltage verification tests. The MCOV check shall consist of a minimum of one (1) hour burn-in at the applicable MCOV.

F.

1.5 SYSTEM DESCRIPTION

- A. Environmental Requirements
 - 1 Storage Temperature: Storage temperature range shall be -40° to +85° C (-40° to +185° F).
 - 2 Operating Temperature: Operating temperature range shall be -40° to +60° C (-40° to 140° F).
 - 3 Relative Humidity: Operation shall be reliable in an environment with 5% to 95% non-condensing relative humidity.
 - 4 Operating Altitude: The device shall be capable of operation in an altitude of 0 12,000 feet above sea level.
 - 5 Audible Noise: The device shall not generate any audible noise.
 - 6 Magnetic Fields: No appreciable magnetic fields shall be generated. The device shall be capable of use directly in computer rooms in any location without danger to data storage systems or devices.
 - 7 Electrical Requirements
 - 8 Device Operating Voltage: The nominal operating voltage and configuration shall be that of the switchgear, distribution panel, sub or branch panelboard. Maximum Continuous Operating Voltage (MCOV): The allowable maximum continuous operating voltage of all suppression components utilized in the unit shall not be less than 115% of the nominal operating voltage.
 - 9 Operating Frequency: The operating frequency range of the device shall be 47 to 63 Hertz.

10 Protection Modes: The devices primary mode of protection shall be line-to-neutral. The secondary modes of protection shall be line-to-ground and neutral-to-ground.

11 Surge Current Capacity and Voltage Protection Rating: Unless specifically noted on the drawings and/or the schedules, the surge current capacity, and the voltage protection rating of the SPD shall be not less than listed on the following table.

The above text gives you the option to request a specific surge current rating on the riser or panel schedules

5. Construction: SPD's with a surge current rating of greater than 155,000 amps per mode shall be field serviceable modular devices. SPD's with a surge current rating of less than 155,000 amps may be non-modular.

	Per Mode	120/2	277/480vac
Location	Surge	08vac	3 phase VPR
	Current	3	
	Rating	phase	
	_	VPR	
Switchgear	200,000	900v	1200v
	amps		
Distribution	150,000	900v	1200v
Panel	amps		
Sub or Branch	100,000	900v	1200v
Panel	amps		

1.6 DOCUMENTATION

A. Equipment Manual. The manufacturer shall furnish an equipment manual with installation, operation, and maintenance instructions for the system.

PART 2 - PRODUCTS

3.1 MANUFACTURER

- 1 Square D
- 2 Cutler-Hammer
- 3 Current Technology
- 4 THOR SYSTEMS

3.2 TRANSIENT VOLTAGE SURGE SUPPRESSION COMPONENTS

A. The device shall include a solid-state suppression system which includes arrays of fused non-linear voltage dependent metal oxide varistors (MOV's) with similar operating characteristics. The suppression system shall not utilize gas tubes, spark gaps, silicon avalance diodes or other components which might short or crowbar the line, thus leading to interruption of normal power flow to or system upset of connected loads. The suppression system shall not incorporate any other components which may degrade performance or reliability of the

3.3 HIGH-FREQUENCY FILTER

A. The device shall include a UL 1283 high frequency extended range tracking filter. The filter shall reduce fast rise-time, high-frequency, error-producing transients and electrical line noise eliminating disturbances which may lead to system upset. The filter shall provide minimum insertion loss of 45 dB at 100 kHz attenuation frequency utilizing the MIL-STD-E220A 50 ohm insertion loss methodology.

3.4 INTERNAL CONNECTIONS

a. All internal wiring associated with the suppression/filter device and subject to surge currents shall utilize low-impedance copper bus bar and/or #4 AWG copper conductor or larger. All internal connections associated with the suppression/filter device and subject to surge currents shall be made with compression solderless-type lugs and shall be bolted to the bus bars in order to reduce overall system impedance.

3.5 FIELD CONNECTIONS

A. The device shall include mechanical lugs for each phase, neutral and ground, or permanently connected conductors as applicable. The lugs shall accommodate up to #4 AWG copper conductor.

3.6 ENCLOSURE

A. The device shall be provided in a surface mounted NEMA 1 type hinged enclosure, with a NEMA rating that matches or exceeds that of the switchgear, distribution panel, sub or branch panelboard that is being protected. of minimum 14 gauge steel, painted inside and out. Enclosure width shall not be greater than 24 inches.

3.7 MONITORING

- a. The device shall include solid-state, long-life externally mounted LED visual status indicators that indicate the on-line status of each phase of the unit.
- b. Dry Contacts
- c. Audible alarm with silence switch
- d. For Service Entrance or Switchgear SPD's: LED visual status indicators, Audible alarm with silence switch, Dry Contacts plus Surge Event Counter.

PART 3 - EXECUTION

- 3.1 INSTALLATION
 - A. The installation and testing of the system shall be in full accordance with the manufacturer's installation, operation and maintenance instructions, and all national and local codes.
 - B. The device shall be installed as close as practical to the facility's wiring system in accordance with NEC Article 285, IEEE 1100-2005 section 8.4.2.5, plus applicable national/local electrical codes and the manufacturer's recommended installation instructions. Connection shall be from a minimum 40A branch circuit breaker in the switchgear, distribution panel or panelboard with #4 AWG copper conductors not any longer than necessary, avoiding unnecessary bends. Advise the engineer if the installed In no case shall conductors will be longer than 3 feet in length. Verify circuit breaker size with manufacturer.

3.2 TESTING

- A. The system shall be field tested in the presence of the Owner. At the same time operational procedures shall be reviewed with the Owner.
- B. If external test equipment is required, two (2) testers shall be furnished to the owner and two (2) training sessions shall be furnished. The first training session shall be with 90 days of occupancy and the second training session shall be not less eight months, but not more than 12 months after the first training session. Training and test equipment shall be furnished at no additional cost to the owner.

SECTION 26 51 00

INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.
- 1.2 SUMMARY
 - A. This Section includes interior lighting fixtures, lighting fixtures mounted on exterior building surfaces, emergency lighting units, and accessories.
 - B. Related Sections include the following:

1.3 SUBMITTALS

- A. Product Data: For each type of lighting fixture indicated, arranged in order of fixture designation. Include data on features, accessories, and the following:
 - 1. Dimensions of fixtures.
 - 2. Select one of two subparagraphs below. With second subparagraph, photometric tests by manufacturer's laboratory are acceptable.
 - 3. Certified results of laboratory tests for fixtures and lamps for photometric performance.
 - 4. Emergency lighting unit battery and charger.
 - 5. LED lights
 - 6. Retain two subparagraphs below for projects with air-handling fixtures.
 - 7. Types of lamps.
- B. Shop Drawings: Show details of nonstandard or custom fixtures. Indicate dimensions, weights, method of field assembly, components, features, and accessories.
 - 1. Wiring Diagrams: Detail wiring for fixtures and differentiate between manufacturer-installed and field-installed wiring.
- C. Consider retaining paragraph below for projects with congested ceiling space and where Drawings do not include comprehensive reflected ceiling plans.
- D. Coordination Drawings: Reflected ceiling plans and sections drawn to scale and coordinating fixture installation with ceiling grid, ceiling-mounted items, and other components in the vicinity. Include work of all trades that is to be installed near lighting equipment.
- E. Product Certificates: Signed by manufacturers of lighting fixtures certifying that products comply with requirements.
- F. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- G. Maintenance Data: For lighting fixtures to include in maintenance manuals in the close out documents.

1.4 QUALITY ASSURANCE

- A. Fixtures, Emergency Lighting Units, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an acceptable to authorities having jurisdiction.
- B. Comply with NFPA 70.
- C. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.
- 1.5 COORDINATION
 - A. Fixtures, Mounting Hardware, and Trim: Coordinate layout and installation of lighting fixtures with ceiling system and other construction.
- 1.6 EXTRA MATERIALS
 - A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products indicated in the Interior Lighting Fixture Schedule at the end of Part 3.
- B. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the Interior Lighting Fixture Schedule in the plans. Submit Manufacturers as is in the Lighting Fixture Schedule or Equal. Submit Equal Manufacturers 10 days prior to bidding day for approval. For Equal Manufacturers submit lighting calculation for each equal fixture submitted for approval.
- 2.2 FIXTURES AND FIXTURE COMPONENTS, GENERAL
 - A. Metal Parts: Free from burrs, sharp corners, and edges.
 - B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
 - C. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position.
 - D. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
 - 4. Laminated Silver Metallized Film: 90 percent.
 - E. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or annealed crystal glass, unless otherwise indicated.
 - 1. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.
 - 2. Lens Thickness: 0.125 inch (3 mm) minimum, unless greater thickness is indicated.

2.3 LED FIXTURES

- A. Except as otherwise indicated, provide LED luminaires, of types and sizes indicated on fixture schedules.
- B. Include the following features unless otherwise indicated:
 - 1. Each Luminaire shall consist of an assembly that utilizes LEDs as the light source. In addition, a complete luminaire shall consist of a housing, LED array, and electronic driver (power supply).
 - 2. Each luminaire shall be rated for a minimum operational life of 50,000 hours utilizing a minimum ambient temperature of (25°C).
 - 3. Light Emitting Diodes tested under LM-80 Standards for a minimum of 12,000 hours.
 - 4. Color Rendering Index (CRI) of 82 at a minimum.
 - 5. Color temperature [3500] <Insert value> K, unless otherwise indicated.
 - 6. Rated lumen maintenance at 70% lumen output for 50,000 hours, unless otherwise indicated.
 - 7. Fixture efficacy of 60 Lumens/Watt, minimum.
 - 8. 5 year luminaire warranty, minimum.
 - 9. Photometry must comply with IESNA LM-79.
 - 10. The individual LEDs shall be constructed such that a catastrophic loss of the failure of one LED will not result in the loss of the entire luminaire.
 - 11. Luminaire shall be constructed such that LED modules may be replaced or repaired without the replacement of the whole fixture.
- C. Technical Requirements
 - 1. Luminaire shall have a minimum efficacy of 60 lumens per watt. The luminaire shall not consume power in the off state.
 - 2. Operation Voltage: The luminaire shall operate from a 50 HZ to 60 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.
 - 3. Power Factor: The luminaire shall have a power factor of 0.9 or greater.
 - 4. THD: Total harmonic distortion (current and voltage) induced into an AC power line by a luminaire shall not exceed 15 percent.

- 5. Operational Performance: The LED circuitry shall prevent visible flicker to the unaided eye over the voltage range specified above.
- D. Thermal Management
 - 1. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the luminaire over the expected useful life.
 - 2. The LED manufacturer's maximum thermal pad temperature for the expected life shall not be exceeded.
 - 3. Thermal management shall be passive by design. The use of fans or other mechanical devices shall not be allowed.
 - 4. The luminaire shall have a minimum heat sink surface such that LED manufacturer's maximum junction temperature is not exceeded at maximum rated ambient temperature.

2.4 LED EXIT SIGNS

- A. Exit light fixtures shall meet applicable requirements of NFPA and UL.
- B. Housing and door shall be die-cast aluminum.
- C. For general purpose exit light fixtures, door frame shall be hinged, with latch. For vandal-resistant exit light fixtures, door frame shall be secured with tamper-resistant screws.
- D. Finish shall be satin or fine-grain brushed aluminum.
- E. There shall be no radioactive material used in the fixtures.
- F. Fixtures:
 - 1. Inscription panels shall be cast or stamped aluminum a minimum of 2.25 mm (0.090 inch) thick, stenciled with 150 mm (6 inch) high letters, baked with red color stable plastic or fiberglass. Lamps shall be luminous Light Emitting Diodes (LED) mounted in center of letters on red color stable plastic or fiberglass.
 - 2. Double-Faced Fixtures: Provide double-faced fixtures where required or as shown on drawings.
 - 3. Directional Arrows: Provide directional arrows as part of the inscription panel where required or as shown on drawings. Directional arrows shall be the "chevron-type" of similar size and width as the letters and meet the requirements of NFPA 101.
 - G. Voltage: Multi-voltage (120 277V).

2.5 EMERGENCY LIGHTING UNITS

- A. General Requirements: Self-contained units. Comply with UL 924. Units include the following features:
 - 1. Battery: Sealed, maintenance-free, lead-acid type with minimum 5-year nominal life and special warranty.
 - 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - 3. Operation: Relay automatically turns lamp on when supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps, and battery is automatically recharged and floated on charger.
- 2.6 LAMPS
 - A. ALL LED NO LAMPS
- 2.7 FINISHES
 - A. Fixtures: Manufacturer's standard, unless otherwise indicated.
- PART 3 EXECUTION

3.1 INSTALLATION

- A. Fixtures: Set level, plumb, and square with ceiling and walls, and secure according to manufacturer's written instructions and approved submittal materials. Install lamps in each fixture.
- B. NFPA 70 requires minimum support for fixtures. Retain paragraphs below for more specific support requirements and for requirements exceeding code minimums. Units in seismic zones must have additional supports and restraining devices beyond those specified here. See Editing Instruction No. 3 in the Evaluations.
- C. Support for Fixtures in or on Grid-Type Suspended Ceilings: Do not use grid for support.

- 1. Install a minimum of two ceiling support system wires for each fixture. Locate not more than 6 inches (150 mm) from fixture corners.
- 2. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture corner.
- 3. Fixtures of Sizes Less Than Ceiling Grid: Arrange as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.
- D. Suspended Fixture Support: As follows:
 - 1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.

3.2 CONNECTIONS

- A. Ground equipment.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Advance Notice: Give dates and times for field tests.
- C. Provide instruments to make and record test results.
- D. Tests: As follows:
 - 1. Verify normal operation of each fixture after installation.
 - 2. Emergency Lighting: Interrupt electrical supply to demonstrate proper operation.
 - 3. Verify normal transfer to battery source and retransfer to normal.
 - 4. Report results in writing.
- E. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.
- F. Corrosive Fixtures: Replace during warranty period.

3.4 CLEANING AND ADJUSTING

- A. Clean fixtures internally and externally after installation. Use methods and materials recommended by manufacturer.
- B. Adjust aimable fixtures to provide required light intensities.

SECTION 26 56 00

EXTERIOR LIGHTING

PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.
- 1.2 SUMMARY
 - A. This Section includes exterior lighting units with luminaries and lamps.
 - B. Related Sections include the following:
 - 1. Section "Interior Lighting" for interior fixtures, lamps, ballasts, emergency lighting units, and accessories; and for exterior luminaires normally mounted on buildings.

1.3 DEFINITIONS

- A. Lighting Unit: A luminaire or an assembly of luminaires complete with a common support, including pole, post, or other structure, and mounting and support accessories.
- B. Luminaire (Light Fixture): A complete lighting device consisting of lamp(s) and ballast(s), when applicable, together with parts designed to distribute light, to position and protect lamps, and to connect lamps to power supply.

1.4 SUBMITTALS

- A. Product Data: For each type of lighting unit indicated, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
 - 1. Materials and dimensions of luminaries.
 - 2. Certified results of independent laboratory tests for fixtures and lamps for electrical ratings and photometric data.
 - 3. Certified results of laboratory tests for fixtures and lamps for photometric performance.
 - 4. High-intensity-discharge luminaire ballasts.
- B. Product Certificates: Signed by manufacturers of lighting units certifying that products comply with requirements.
- C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- D. Maintenance Data: For lighting units to include in maintenance manuals specified in other sections.
- 1.5 QUALITY ASSURANCE
 - A. Luminaires and Accessories: Listed and labeled as defined in NFPA 70, Article 100, for their indicated use, location, and installation conditions by acceptable to authorities having jurisdiction
 - B. Comply with ANSI C2.
 - C. Comply with NFPA 70.
- 1.6 WARRANTY

A. General Warranty: LED fixture warranty is a five year limited warranty. Pole standard warranty is one year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products indicated in the Exterior Lighting Unit Schedule at the end of Part 3.
- B. Retain above for nonproprietary or below for semiproprietary Specification, and name products in schedules or details.
- C. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the Interior Lighting Fixture Schedule in the plans. Submit Manufacturers as is in the Lighting Fixture Schedule or Equal. Submit Equal Manufacturers 10 days prior to bidding day for approval. For Equal Manufacturers submit lighting calculation for each equal fixture submitted for approval.
- 2.2 LUMINAIRES
 - A. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
 - B. Metal Parts: Free from burrs, sharp corners, and edges.

- C. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- D. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- E. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position. Provide for door removal for cleaning or replacing lens. Arrange to disconnect ballast when door opens.
- F. Exposed Hardware Material: Stainless steel.
- G. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.
- H. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
- I. Lenses and Refractors: Materials as indicated. Use heat- and aging-resistant, resilient gaskets to seal and cushion lens and refractor in luminaire doors.
- J. Photoelectric Relays: As follows:
 - 1. Contact Relays: Single throw, arranged to fail in the on position and factory set to turn light unit on at 1.5 to 3 fc (16 to 32 lx) and off at 4.5 to 10 fc (48 to 108 lx) with 15-second minimum time delay.
 - 2. Relay Mounting: In luminaire housing.
- K. LED sources shall meet the following requirements:
 - 1. Operating temperature rating shall be between -40 degrees C (-40 degrees F) and 50 degrees C (120 degrees F).
 - 2. Correlated Color Temperature (CCT): 4000K
 - 3. Color Rendering Index (CRI): ≥ 85 .
 - 4. The manufacturer shall have performed reliability tests on the LEDs luminaires complying with Illuminating

LED DRIVERS

- A. LED drivers shall meet the following requirements:
 - 1. Drivers shall have a minimum efficiency of 85%.
 - 2. Starting Temperature: -40 degrees C (-40 degrees F).
 - 3. Input Voltage: 120 to 480 (\pm 10%) volt.
 - 4. Power Supplies: Class I or II output.
 - 5. Surge Protection: The system must survive 250 repetitive strikes of "C Low" (C Low: 6kV/1.2 x 50 μs, 10kA/8 x 20 μs) waveforms at 1-minute intervals with less than 10% degradation in clamping voltage. "C Low" waveforms are as defined in IEEE/ASNI C62.41.2-2002, Scenario 1 Location Category C.
 - 6. Power Factor (PF): ≥ 0.90 .
 - 7. Total Harmonic Distortion (THD): $\leq 20\%$.
 - 8. Comply with FCC Title 47 CFR Part 18 Non-consumer RFI/EMI Standards.
 - 9. Drivers shall be reduction of hazardous substances (ROHS)-compliant.//

PART 3 - EXECUTION

3.1 CONNECTIONS

- A. Ground equipment.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

- B. Ground metal poles/support structures according to Section "Grounding and Bonding."
 - 1. Nonmetallic Poles: Ground metallic components of lighting units and foundations. Connect luminaires to grounding system with No. 6 AWG conductor.

3.2 FIELD QUALITY CONTROL

- A. Inspect each installed unit for damage. Replace damaged units.
- B. Advance Notice: Give dates and times for field tests.
- C. Provide instruments to make and record test results.
- D. Tests and Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source, and as follows:

3.3 CLEANING AND ADJUSTING

A. Clean units after installation. Use methods and materials recommended by manufacturer.

SECTION 27 05 33

CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

- 1.1 RELATED REQUIREMENTS
 - A. The General Provisions, Supplemental General Provisions, Special Provisions apply to work covered by this Section.
 - B. Comply with Sections 26 00 00, as applicable. Refer to other Sections for coordination of work.

1.2 SCOPE OF WORK

- A. Provide labor, materials, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of a telephone and data communications empty conduit system, including all related systems and accessories.
- 1.3 SUBMITTALS
 - A. Submit product data and shop drawings in accordance with the Architectural sections.
- PART 2 PRODUCTS

2.1 GENERAL

- A. Conduit, conduit sleeves, outlet boxes, cover plates and pullwire as indicated.
- B. Fireproofing material for telephone and data communication conduit and conduit sleeves through fire rated walls and floors.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install telephone and data communication raceways as indicated.
- B. Install individual raceways from telephone and data communications outlets to above accessible ceiling. In areas without a ceiling, raceways shall be routed to the nearest ceiling space. In building without a ceiling, raceways shall be extended back to the main telephone/ data communication board or to a location indicated on the Drawings.
 - 1 Minimum size conduit: 1.25 inch, REFER TO PLANS FOR SIZES.
 - 2 Raceway installation shall be in accordance with Section 26 05 33.
 - 3 Coordinate raceway installations in millwork and other fabricated architectural items with the other portions of the Work.
 - 4 Provide pullwire in each raceway tagged on each end.
 - 5 Raceways shall be terminated with an insulating bushing or a suitable connector with an insulated throat.
- C. Provide telephone and data communications outlet boxes.
 - 6 Provide a one-gang outlet unless noted otherwise.
 - 7 Install outlet box and device ring at each location.
 - 8 Install telephone and data communications outlets at same height specified for convenience outlets unless noted otherwise. Group telephone and data communications outlets with related receptacle outlets unless noted otherwise.
 - 9 Install a blank cover plate on all unused communications outlet boxes.

SECTION 28 31 00

INTRUSION DETECTION

PART 1 - GENERAL

- 1.1 Manufacturer
- A. The manufacturer shall have at least twenty-five (25) years of experience in the role of fire and security control manufacturing, and a proven track record of forward and backward compatibility for a minimum of twenty (20) years for its product's auxiliary devices, including system keypads, annunciation devices, zone expansion modules, and addressable detection devices.
- B. The manufacturer must also manufacture receiving equipment that is compatible with standard dial-up telephone lines and network monitoring equipment that is compatible with a LAN, WAN, and the Internet. The receiving equipment shall be capable of receiving all status and alarm messages generated by the system. The receiving equipment shall be capable of updating the panel operating program and the system date and time.
- C. Intrusion detection/Access control pane(SEC) equipment manufacturer shall be: Digital Monitoring Products, Incorporated (DMP) #XR500N
- 1.2 Installer
- A. The installing company shall show proof of having regular experience with design, installation, service, and maintenance of manufactured systems for a minimum of the last twelve (12) calendar months from the project start date. Each system installer and service person must provide manufacturer certification of technical training for installation, service, and system maintenance. Certification shall be proven with an official document issued by the manufacturer.
- B. The installing company shall provide a minimum of 8 (eight) verifiable references from its clients where the manufacturer's system has been installed within the last twelve (12) calendar months from the project start date.
- C. The installing company shall furnish and install a complete electrically supervised Command Processor[™] Panel, as detailed in this specification. The system shall be inclusive of all necessary function, monitoring, and control capability as detailed herein and on accompanying shop drawings.
- D. The installing company shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Architect of any discrepancy before performing the work. Materials shall be installed in strict compliance with local building codes. All work shall be performed in accordance with Digital Monitoring Products, Inc. instructions.
- 1.3 Central Reporting Station
- A. The central reporting station contractor must possess an Underwriter's Laboratory (UL) listing as a "Mercantile Police Station" or "Mercantile Burglar Alarm Systems" company. A copy of the listing shall be attached as a part of this bid package.
- B. The actual alarm signal receipt and processing is a significant portion of the scope of work. Third party and/ or contract stations are permitted. UL must list the monitoring station for Protective Signaling Services or Central Reporting Station Signaling Services. A copy of the station UL listing shall be attached as part of this bid package.
- C. The monitoring station must provide openings/ closing activity reports, activity day and time, authorized individual, office name and account number and the system type being monitored. These reports are to be mailed to the user's office at the end of each month. The Office Manager or Contract Administrator may request an additional report if an incident occurs.
- D. The contractor must have a valid Alarm Operator License. A copy of licenses shall be attached as part of this bid package.
- E. The contractor may be required to monitor a portion of the alarm systems by way of the end user data network.
- F. The Contractor shall become familiar with all work details, verify all dimensions in the field, and shall advise the Architect of any discrepancy before performing the work.

G. The end user shall not incur any central station setup charges by the contractor to receive alarm signals by way of the end user data network.

PART2 - SCOPE

- 2.1 Requirements
 - A. Furnish and install a complete Intrusion Detection/ Access Control system (SEC) with the performance criteria detailed in this specification. The system shall be inclusive of all necessary functions, monitoring, and control capability as detailed herein and on accompanying Shop drawings.
 - On-site or remote video monitoring
 - Heating, air conditioning, and lighting management
 - Temperature threshold detection and monitoring
 - Humidity threshold detection and monitoring
 - Pressure threshold detection and monitoring
 - Power loss detection and monitoring, generator switching
 - Leak detection and monitoring
 - Carbon Monoxide detection and monitoring
 - Tank level threshold detection and monitoring
 - B. This specification document provides the requirements for the installation, programming, and configuration of a complete Command Processor Panel. This system shall include, but not be limited to:
 - Control panel
 - System cabinet
 - Power supply
 - Digital Signaling Line Circuits (SLC)
 - Notification Appliance Circuits (NAC)
 - Annunciator/keypad bus
 - Batteries
 - Wiring
 - Conduit
 - Associated peripheral devices
 - Other relevant components and accessories required to furnish and install a complete and operational addressable reporting Life Safety System.

2.2 Standards

A. The system shall be listed as a Power Limited Device and be listed under the standards in the table. Each system shall be supplied with complete details on all installation criteria necessary to meet all of the listings.

Burglary Listings

- UL 365 Police Connect Burglar
- UL 609 Local Burglar
- UL 1023 Household Burglar Alarm System Units
- UL 1076 Proprietary Burglar
- UL 1610 Central Station Burglar Alarm Units
- UL 1635 Digital Burglar Alarm Communicator System Units

Fire Listings

- UL 864 Control Units for Fire Protective Signaling Systems
- UL 985 Household Fire Warning
- Access Control Listings
 - UL 294 Access Control System Units

Related Listings

- NFPA 70 National Electric Code (NEC)
- NFPA 72 Local Protective Signaling

- NFPA 72 Remote Station Protective Signaling
- NFPA 72 Proprietary Protective Signaling
- NFPA 72 Household Fire Warning
- U.S. Government Standards/Listings
 - Meets DCID 6/9
 - Meets DoD/NIST SCIF Standards

2.3 Americans with Disabilities

All indicating and notification appliances shall comply with the Americans with Disabilities Act (ADA) requirements.

PART 3 - SUBMITTALS

3.1 General Requirements

The contractor shall submit three (10) complete sets of documentation within thirty (30) calendar days after contract award date. Indicated in the document shall be the manufacturers' names, catalog number, type, size, style, rating, and catalog data sheets for all items proposed to meet these specifications.

3.2 Shop Drawings

Shop drawings shall be submitted in accordance with Section 3.0 Submittals and shall consist of a complete list of equipment and materials, including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions.

3.3 As-Built Drawings

The contractor shall provide a complete set of as-built drawings for the entire system upon installation completion. These drawings shall include, but not be limited to, the exact locations of all equipment, connections between all equipment, and wiring for all equipment as the system is installed.

3.4 Spare Parts Data

After shop drawings are approved, and not later than thirty (30) calendar days prior to the date of beneficial occupancy, a list of spare parts data for each item of specified materials and equipment shall be submitted. The data shall include a complete list of parts and supplies with current unit prices and source of supply. Spare parts shall consist of, but not be limited to, five (5) percent of all initiating and notification appliances with a minimum of one (1) each. All spare parts shall be on site prior to commencement of acceptance testing. Depleted spare parts shall be replaced prior to beneficial occupancy.

3.5 Operating Documents

The contractor shall furnish to the architect operating instructions outlining the step-by-step procedures required for system start-up, operation, and shutdown at least thirty (30) calendar days prior to acceptance test. The instructions shall include the manufacturer's name, system model number, service manual, parts list, and a description of all equipment and their basic operating features.

3.6 Maintenance Documents

The contractor shall furnish maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides at least 30 calendar days prior to acceptance test.

3.7 Performance Test Reports

Upon the installed system completion and testing, test reports shall be submitted in booklet form showing all field tests performed to prove compliance with specified performance criteria.

3.8 Warranty

A copy of the manufacturer's warranty for all equipment and materials shall be provided. Warranty shall be for all equipment, materials, installation, and workmanship for a minimum of three (3) years, unless otherwise specified.

PART 4 - GENERAL COMPONENT REQUIREMENTS

4.1 Component Enclosure

Housings; power supply enclosures, terminal cabinets, control units, and other component housings, collectively referred to as enclosures shall be so formed and assembled as to be sturdy and rigid. If sheet steel is used in the fabrication of enclosures, it shall be not less than an 18 gauge door with a 20 gauge box frame. Where exposed pins, the hinges shall be of the tight pin type or the ends of hinge pins shall be tack welded to prevent ready removal. Doors having a latch edge length of less than 24 inches shall be provided with a single lock. Where the hinged door latch edge is 24 inches or more in length, doors shall be provided with three-point latching device with lock; or

alternatively with two locks, one located near each end. For SCIF and High Security applications an attack proof enclosure with proper tampers UL listed for use with the XR500/XR500N/XR500E shall be used.

4.2 Electronic Components

- A. All system electronic components shall be solid-state type, mounted on printed circuit boards. Light duty relays and similar switching devices shall be solid-state type or electromechanical.
- B. The panel shall have an over current notification LED that lights when devices connected to the Keypad Bus and LX-Bus(es) draw more current than the panel is rated for. When the over current LED lights, the LX-Bus (es) and Keypad bus are shut down.

4.3 Control Unit

- A. A battery test shall be automatically performed to test the integrity of the standby battery. The test shall disconnect the standby battery from the charging circuit and place a load on the battery. This test shall be performed no more than every 180 seconds.
- **B.** The control unit shall be capable of operating and supervising notification appliance devices as well as addressable initiating detection devices and an integrated supervised dual line digital communicator.

4.4 Remote Annunciators

- A. The system shall support a maximum of sixteen (16) supervised remote annunciators with the identical capabilities, functions and display layout. Operation of the remote annunciators shall be limited to authorized users by the use of a code or key.
- **B.** The remote annunciators shall be capable of operating at a maximum wiring distance of 15,000 feet from the control unit on unshielded, non-twisted cable.

4.5 Control Designations

Controls shall be provided to ensure ease of operation of all specified characteristics. Where applicable, clockwise rotation of controls shall result in an increasing function. Controls, switches, visual signals and indicating devices, input and output connectors, terminals and test points shall be clearly marked or labeled on the hardware to permit quick identification of intended use and location.

4.6 Test Modes

- A. The system shall include a provision that permits testing from any alphanumeric keypad. The test shall include standby battery, alarm bell or siren, and communication to the central station.
- **B.** The system shall include a provision for an automatic, daily, weekly, thirty (30) day, or up to sixty (60) day communication link test from the control panel installation site to the central station.
- C. The system shall include a provision for displaying the internal system power and wiring conditions. Internal monitors shall include the bell circuit, AC power, battery voltage level, charging voltage, panel box tamper, phone trouble line 1, phone trouble line 2, transmit trouble, and network trouble.

4.7 Serial Interface

The control panel shall be capable of a serial interface to output information to a standard serial printer or serial interface to a communication port on a standard computer. Through control panel programming the system shall include a provision to allow the selection of which reports are to be output.

4.8 Power Supplies

- A. Power supplies for the control unit shall operate from 120 VAC, supplied at the respective protected areas. Standby batteries shall be supplied to power the system in the event of a utility power failure. Batteries shall be sized to provide 105% capacity for eight hours. Standby batteries shall be sealed lead-acid. Power supplies shall be all Solid State.
- B. Controls shall be designed to maintain full battery charge when alternating current is available. Batteries shall be recharged to 85% capacity within 24 hours from battery use. The system shall be automatically transferred to battery power upon loss of alternating current power and return to alternating current power upon restoration. Intrusion alarms shall not be initiated during switch over; a signal shall be initiated upon failure of battery or alternating current power.
- C. Approved power supplies shall meet or exceed the following power supply model specifications:
 - UL Listed DMP 505-12: 12VDC 5 amp with transformer and enclosure.
 - UL Listed DMP 504-24: 24 VDC 4 amps with transformer and enclosure.

4.9 Software

- A. The system shall interface with computer software with the capability to fully program the panel by connecting to the panel through:
 - Direct cable connection interface card
 - Receiver phone line connection
 - Standard phone line connection
 - Ethernet network connection
 - Network connection across the Internet
- B. The system shall interface with computer software capable of locking down all controlled doors.
- C. The system shall interface with computer software capable of monitoring and logging all events.
- D. The system shall interface with computer software capable of exporting reports in the following file formats:
 - Excel spreadsheet Text (*.txt)
 - (*.xls)
 - Commaseparated (*.csv)
 - Windows Metafile (*.wmf)

• Rich Text (*.rtf)

- HTML document (*.htm)
- QuickReport (*.qrp)

E. The system shall interface with computer software capable of printing custom, filtered reports including:

- All Events
 - Door Access Granted
 Door Access Denied
- Zone Action
- Opening/Closing
- Arming/Disarming Area Late to Close
- Schedule Changes
- User Code Changes
- System MonitorsSystem Events
- 4.10 Control Panel Capability

The basic control panel shall provide:

- Expansion to a total of at least 10,000 user codes with 99 user profile definitions.
- Sixteen (16) independent door/keypad addresses, each with four zones.
- Twenty (20) Holiday Dates for custom holiday scheduling by area.
- A total door access granted event buffer of at least 10,000 events.
- Anti-passback access control selectable by area and user.
- Four (4) shift schedules per area.
- A total of at least 100 programmable output relay schedules.
- Thirty-two (32) individual reporting areas.
- Built-in bell and telephone line supervision.

The networked control panel shall provide:

- All of the above features.
- Require two-man access code or credentials.
- Support programming to require the same or different access code entered within a programmed delay time of 1 to 15 minutes after disarming before activating a silent ambush alarm.
- Support area programming that disables schedule and time-of-day changes while system is armed so that area can only be disarmed during scheduled times.

The encrypted control panel shall provide:

- All of the basic and network features listed above.
- Built-in Encrypted Alarm Router.
- Certified operation that meets 128 Bit AES Rijndael Encryption communications.
- Certified operation that meets SCIF (Sensitive Compartmented Information Facility) application needs.
- Certified operation that meets NIST (National Institute of Standards and Technology) standards.

- Certification that encrypted panel is capable of meeting DCID 6/9 standards.
- Certification that encrypted panel is capable of meeting UL 2050 standards.
- PART 5 FUNCTIONAL DESCRIPTIONS
 - 5.1 System Description
 - A. The system areas and zones shall be programmable, and the system shall store, log, display, and transmit specific custom designations for system areas, zones, and user names.
 - **B.** To ensure continued, one-call support, the system shall be constructed of sensing components provided directly by the system manufacturer, such as power supplies, motion detectors, door and window position switches, glass break detectors, or other sensing devices that the manufacturer offers.
 - C. The system controller, user interfaces, zone input devices, relay output devices, and the system signal receiving equipment shall be engineered, manufactured, assembled, and must be distributed from a location within the United States of America.
 - D. The system shall support user interaction by way of a keypad, web browser, system software, key switch, or radio frequency wireless control, using integrated or auxiliary devices provided by the system manufacturer.
 - E. The system shall support controller zone input connections, system keypads, system zone expansion modules, and wireless zone input modules, and must support zone input connections by way of at least two competitive products. The system shall offer a seamless integrated compatibility with hard-wire and/ or wireless zone expansion equipment for at least 200 wireless zones and/ or a maximum of 574 hardwired zones.
 - F. The system shall be capable of offering at least five zone expansion buses, each of which can support the connection of up to 15,000 feet of four-wire cable. Zone expansion and keypad data buses that exceed 2,500 feet of cable must include splitter/repeater modules to boost data voltage and maintain data integrity.
 - G. The system shall provide a seamless capability to provide a minimum of 500 addressable relays, which can be located at any connection location upon a zone expansion bus.
 - H. System relay outputs shall have the capability of being triggered as a result of a command from the user interface, changes in system status, changes in zone status, or by a programmable schedule.
 - I. System relay output states shall be programmable for momentary, maintained, pulsed, or must follow the state of an associated system zone input.
 - J. The system shall be completely programmable either locally from a keypad or remotely through a standard dial-up, and network connections by way of a LAN, WAN, and/or by way of the Internet.
 - K. The control unit shall be completely programmable remotely using remote annunciators, and/ or using upload/ download software that communicates using SDLC 300 baud, 2400 baud, or IP Addressed data network. On-site programming from a personal computer shall also be permitted.
 - L. The control unit shall be equipped with an anti-reversing circuit breaker to prevent damage due to accidental reversal of battery leads.

5.2 Input/Output Capacity

- A. This system shall be capable of monitoring a maximum of 574 individual zones and controlling a maximum of 502 output relays.
- B. The control panel shall have, as an integral part of the assembly, 2 SPDT Form C relays rated at 1 Amp at 30 VDC and four open collector 12 VDC outputs rated at 50mA each. It shall also have the capacity of a maximum of 125 output expander modules with 500 switched ground, open collector outputs, 50mA maximum and 502 auxiliary relays (Form C rated at 1.0 Amp at 30 VDC).
- C. The panel shall also provide 100 programmable output schedules, and include an integral bell alarm circuit providing at least 1.5 Amps of steady, pulsed, or temporal bell output. Output type shall be programmable by zone type. Relays and voltage outputs shall be capable of being independently programmed to turn on and/or off at selected times each day.

5.3 User/Authorization Level Capacity

D. The system shall be capable of operation by 10,000 unique Personal Identification Number (PIN) codes with each code having one (1) of ninety-nine (99) custom user profiles. This allows for limitation of certain functions to authorized users. The operation of all keypads shall be limited to authorized users.

5.4 Keypads

- A. The keypads shall be DMP # 7063. The system shall support a maximum of sixteen (16) keypads with alphanumeric display. Each keypad shall be capable of arming and disarming any system area based on a pass code and Proximity key authorization. The keypad alphanumeric display shall provide complete prompt messages during all stages of operation and system programming and display all relevant operating and test data.
- **B.** Communication between the control panel and all keypads and zone expanders shall be multiplexed over a nonshielded multi-conductor cable, as recommended by the manufacturer. This cable shall also provide the power to all keypads, zone expanders, output expanders, and other power consuming detection devices.
- C. If at any time a keypad does not detect polling, the alphanumeric display shall indicate "SYSTEM TROUBLE". If at any time two devices are programmed for the same address, the alphanumeric keypad shall display "4 WIRE BUS TROUBLE". If at any time a keypad detects polling but not for its particular address, the alphanumeric display shall indicate "NON POLLED ADDR". The system shall display all system troubles at selected keypads with distinct alphanumeric messages.
- D. The keypad shall include self-test diagnostics enabling the installer to test all keypad functions: display test, key test, zone test, LED test, relay test, tone test, and address test.
- E. The keypad shall provide an easy-to-read English text display. The text shall exactly match the text seen in all software reports, keypad displays, and central station reports.
- F. The keypad user interface shall be a simple-to-use, menu-driven help system that is completely user friendly.
- G. The control panel shall support a keypad interface accessible on the World Wide Web in a browser window. The web-accessible keypad interface shall provide at least five (5) programmable hyperlinks for camera access or other use.
- H. The system shall support sub-control keypads with four (4) built-in zones and capable of functioning in the following modes:
- Panel monitors all four (4) keypad zones independently with a maximum of 125 keypads attached to the control panel
- Panel assigns one (1) zone to each keypad and monitors all keypad zones as a single zone with a maximum of 500 keypads attached to the control panel
- Stand-alone mode allowing keypad to operate as a self-contained security system independent of the control panel 5.5 Zone Configuration
- A. A minimum of 4 Class B ungrounded zones shall be available at each keypad or zone expander on the system. The system shall have the capacity for a maximum of sixteen (16) keypads and a maximum of 125 four (4) zone expanders or 500 single zone expanders. It shall also have the capacity of a maximum of 125 supervised relay output expanders. All Class B zones shall be 2-wire, 22 AWG minimum, supervised by an end-of-line (EOL) device and shall be able to detect open and short conditions in excess of 500ms duration.
- B. Each zone shall function in any of the following configurations: Night, Day, Exit, Fire, Supervisory, Emergency, Panic, Auxiliary 1, Auxiliary 2, Fire Verification, Cross Zone, Priority, and Key Switch Arming.
- C. The digital SLCs and the annunciator/keypad bus shall be able to operate at a maximum wiring distance of 2500 feet from the control panel on unshielded, non-twisted cable. This distance may be extended to a total of 15,000 feet when bus repeater modules are installed.
- D. The system shall have the capability to incorporate up to 200 zone expander POPITTM points.
- E. Each zone shall function in any of the following configurations:
- 5.6 Communication
 - A. The system shall be capable of signaling to two remote monitoring station receivers, four telephone numbers of 32 digits each using two separate switched telephone network lines such that if two unsuccessful attempts are made on the

Night • Supervisory • Auxiliary 1
Day • Emergency • Auxiliary 2
Zone

- Exit Panic Fire Priority
- Fire Verification Arming

first line to the first number, the system shall make two attempts on first line to the second number. If these two attempts are unsuccessful, the system shall make two further attempts on the first line of the first number. After the tenth unsuccessful attempt, dialing shall stop and the alphanumeric keypad shall display trouble. Should another

event occur that requires a report to be transmitted, the dialing process shall be repeated. The system shall have a programmable option to dial a second set of telephone numbers after the first ten attempts using the same sequence.

- **B.** The system shall be capable of communication using the IBM Synchronous Data Link Control format, and at least two other standard industry formats.
- C. The system shall be capable of supporting Network communication with digital dialer backup, existing Ethernet or token ring data networks, satellite communication, fiber optic networks, local area networks, wide area networks, cellular communication, and retail data networks.
- 5.7 Network Communication
 - A. The control panel shall be capable of asynchronous network communication with a retry time between 3 and 15 seconds for a total of one (1) minute. If communication is unsuccessful the control panel shall be capable of attempting backup communication through any of the available communication methods to the same receiver or a backup receiver.
 - B. Network communication between the control panel and the receiver shall be in a proprietary communication format.
 - C. The control panel shall be capable of supporting Dynamic Host Communication Protocol (DHCP) Internet Protocol (IP) addressing.
 - D. Underwriters Laboratories (UL) shall list network communication by the control panel for Grade AA High-Line Security.
 - E. The control panel shall be capable of two-way network communication using standard Ethernet 10BaseT in a LAN, WAN, or Internet configuration.
 - F. The control panel shall be capable of communication by means of a 128 Bit AES Rijndael Encryption process certified by NIST (National Institute of Standards and Technology) to an SCS-1R receiver with a built-in Encryption Alarm Router.
 - G. The control panel shall be capable of meeting DCID 6/9 and UL 2050 standards.
- 5.8 TCP/IP Network Trapping
 - A. The control panel shall be capable of having communication set to Network operation. When a trap is set in Remote Link, the software shall be capable of sending a panel trap message with the panel account number to the iCOM or iCOM-E installed in an SCS-1R receiver.
 - B. The receiver iCOM or iCOM-E shall store the trap and monitor the panel for the next message. When the panel sends its next message, the receiver iCOM or iCOM-E shall then send a message to the panel to contact Remote Link at the IP address contained in the original trap message.
 - C. The trap message shall be stored in the receiver iCOM or iCOM-E for up to four hours. If the trap message is not sent to the panel within the four-hour window, the panel trap message shall be discarded and a new trap message must be sent from Remote Link.
 - D. The user shall be able to view the trap status in the receiver iCOM or iCOM-E in Remote Link using the Trap Query function.
- 5.9 NAC Circuit Configuration
 - A. The system shall be capable of additional Class B NAC circuits utilizing the Model 867 Notification Module. Each module shall be controlled and supervised via the SLC loop and monitor for short circuits, open circuits, and ground faults. The NAC circuits shall monitor for external NAC trouble conditions.
 - B. The system shall be capable of providing Class A NAC circuits utilizing the Model 865 Notification Module. Each module shall monitor for short circuits, open circuits, and ground faults. The NAC circuits shall monitor for external NAC trouble conditions and have a manual bell silence switch.

PART6- INTEGRATED INTRUSION ALARM AND ACCESS CONTROL OPERATION

6.1 Access Authority Levels

The system shall be capable of programming access credentials authority levels to check whether the user has access to a specific area and also has the authority to disarm or arm the area. If the user access credential has access and disarm/arm authority the system shall provide the user the option to disarm the area simultaneously upon opening the door, or to open the door and begin an entry delay timer. With the timer option the user then disarms the area using an intrusion control keypad inside the area. If the user only has access authority to the area and the area is in an armed condition, the user is denied access to the area.

6.2 Door Open Schedule Override

The system shall be capable of programming certain area doors to be scheduled to unlock and lock at specific times of the day or night. The lock/unlock function shall be capable of an override option depending upon the area armed/disarmed status. If the area remains in an armed status at the scheduled unlock time the armed status overrides the unlock schedule ensuring the doors remain locked and armed in situations where the business might open late, close early, is affected by inclement weather, or another emergency.

6.3 Common Area

The system shall be capable of programming a common area to be armed when the last area in the system is armed and disarmed when the first area in the system is disarmed. To ensure the common area works properly it shall not have any user codes assigned to the common area. The system shall also be capable of programming multiple common areas.

- 6.4 Early Morning Ambush (XR500N and XR500E only)
 - A. The system shall be capable of programming an area to require two user codes be entered within a programmed number of minutes to prevent an ambush message from being sent to the Central Station Receiver. If both user codes are not entered within the time an ambush message is sent to the central station receiver.
 - **B.** Both user codes shall have the authority to disarm the specific area and must be entered at the same keypad or reader. The keypad shall not display any indication that the ambush timer is running.
 - C. The system shall be capable of programming an output to provide an external indicator that an ambush situation is taking place.
- 6.5 Two-Man Rule (XR500N and XR500E only)

The system shall be capable of programming an area to require two separate user codes be entered in order to disarm and/or allow access to a specific area. Both required codes shall have at least the same or greater authority level. Both required codes shall be entered within 30 seconds or an alarm shall activate.

6.6 UL Bank Safe & Vault Operation (XR500N and XR500E only)

The system shall be capable of being programmed to only be disarmed during scheduled times regardless of the authority level of any user code or user profile in the system. The schedule and time and date set for this area shall not be capable of being changed while the area is armed. Zones assigned to Bank Safe & Vault areas shall not be able to be bypassed or force armed.

- 6.7 Panic Button Summary Test (XR500N and XR500E only)
 - A. The system shall have the ability to test panic buttons without sending a panic alarm to the Central Station Receiver.
 - B. The system shall also have the ability to send panic zone test verification and failure results to the Central Station Receiver.
 - C. During the test, each time a panic zone trips, the display number shall increment and the keypad buzzer sound for two seconds.
 - D. The number of panic zones tripped shall constantly display until the test ends or no panic zone activity has occurred for 20 minutes.
 - E. When the Panic Zone Test ends and a zone failed (did not trip) during the test, the keypad shall be able to display the zone name and number and have the buzzer sounds for one second. Additional zone failed zones shall display when a button is pressed.

PART7- FALSE ALARM REDUCTION FEATURES

The system shall be capable of providing false alarm reduction features, functions, capabilities, or processes that either require alarms be verified or potential alarms be corrected before a system or zone can be placed into an armed state.

7.1 Exit Error Alert and Reporting

The panel shall be able to provide an automatic function to prevent a false alarm from occurring if an exit door does not properly close after the system is armed.

7.2 Entry and Exit Delay Annunciation

- A. When arming, the system shall provide clear annunciation indicators to the user about the need to exit the premises prior to the exit delay time expiring.
- B. When disarming, the system shall notify the user the need to disarm the system prior to the entry delay time expiring.

7.3 Remote Annunciation

The system shall be able to provide entry and exit delay time period notification. This notification can be from DMP keypads, remote annunciators, or bell tests.

7.4 Abort Reporting

The system shall be capable of sending an Abort report to the central station if the system is disarmed while the alarm is still sounding. The Abort report shall be sent *after* the alarm report to notify the central station that an authorized user has cancelled the alarm.

7.5 System Testing

The system shall offer testing features that are simple, quick, and complete and provide the highest measure of safety by ensuring that alarm conditions are detected and communicated to the proper authorities in a timely manner and on a regularly scheduled basis.

7.6 Ambush Code

The system shall offer ambush codes for those dangerous encounters where the user is instructed to either arm or disarm the system under threat of harm. The duress code shall disarm the system without giving local indication of an alarm that might put the user well-being in jeopardy.

7.7 Two-Button Panic Feature

The system shall support DMP keypads that provide the option to use only two-button panic codes. The user shall be required to press and hold two designated keys for approximately two seconds before the system generates a panic alarm.

7.8 Fire Verify Zones

The system shall support Fire Verify zones to help the panel verify the existence of an actual fire condition before it sends an alarm report to the central station. The Fire Verify zone shall require the panel to perform a Sensor Reset whenever a device connected to a Fire Verify zone initiates an alarm. This shall begin a verification period during which the panel waits for a second alarm initiation. If the original zone or any other Fire Verify zone on the panel initiates an alarm within the next 120 seconds, the panel shall recognize this as an actual alarm and send an alarm report to the central station.

7.9 Cross-Zoning Protection

The system shall support cross-zoning as a means of requiring two device trips to occur within a short period of time before sounding an alarm and sending an alarm report to the central station. Supported device trips shall be from one device that trips two times, or from two devices that each trip once.

7.10 Swinger Zone Bypassing

The system shall be capable of automatically bypassing a zone if it goes into an alarm or trouble condition a specified number of times within a one-hour period. The panel shall be able to track the number of times the zone trips while armed and compare that against a programmed number. When that number is reached, the panel shall be able to automatically bypass the zone. The panel shall be capable of resetting the zone when the area to which it is assigned disarms, is manually reset from the keypad or remotely, or remains normal for one hour.

7.11 Recently Armed Report

The system shall be capable sending a System Recently Armed report, along with a zone alarm report, to the central station any time an alarm occurs within five minutes of the system arming. The System Recently Armed report allows the central station operator to follow a "call the subscriber first" procedure instead of immediately dispatching the police to what could be a false alarm.

7.12 Transmit Delay

The system shall be capable of programming the panel to wait up to 60 seconds before sending burglary alarm reports to the central station. If an alarm is accidental, the user shall be able to disarm the system within the programmed Transmit Delay time. An Abort report shall be sent in place of an alarm report after the system disarms. During the alarm, sirens and panel relay outputs shall not be delayed and shall still provide local condition annunciation.

7.13 Call Waiting Cancel

The system shall be capable of being programmed to cancel call waiting any time the panel dials the receiver number to send a report.

PART8- PRODUCTS (NOT USED)

PART9- BURGLARY CONTROL SPECIFICATIONS

9.1 Burglary Standards

The Burglary system shall be listed as a Power Limited Device and be listed under the standards in the table below. Each system shall be supplied with complete details on all installation criteria necessary to meet all of the listings.

- 9.2 Area System
 - A. The system user shall be capable of selectively arming and disarming any one or more of 32 areas within the intrusion detection system based on the user PIN code and/or keypad used. Each of the 574 zones shall be able to be assigned to any of the 32 available areas. The system shall be capable of having up to a sixteen (16) character length name programmed for each area.
 - **B.** The system user shall be capable of assigning an opening and closing schedule to all areas or to each of the 32 areas separately. Each area shall be able to arm or disarm automatically by a schedule. The system shall have the capacity for common areas that automatically disarm when any other area disarms and that automatically arm when all others areas arm.
 - C. The networked system shall have the ability to comply with Bank Safe & Vault application. The networked system shall also have the ability to use a two-man rule for disarming or allowing door access to an area. The system shall have the ability to operate a Common Area application.
- 9.3 Zones
 - The system shall have a minimum of eight (8) grounded burglary zones available from the control panel.
- 9.4 Burglary Equipment

Burglary detection equipment shall communicate to the system by way of the control panel loop expansion bus or

Burglary Listings

- UL 365 Police Connect Burglar
- UL 609 Local Burglar
- UL 1023 Household Burglar Alarm System Units
- UL 1076 Proprietary Burglar
- UL 1610 Central Station Burglar Alarm Units
- UL 1635 Digital Burglar Alarm Communicator System Units
- F. Additional Listings
- NFPA 72 Local Protective Signaling
- NFPA 72 Remote Station Protective Signaling
- NFPA 72 Proprietary Protective Signaling
- A. U.S. Government Standards
- Meets DCID 6/9
- Meets DoD/NIST SCIF Standards

900MHz receiver. The detection equipment shall have a three (3) year warranty and meet or exceed features offered in the products listed in Section 9.0 of this document. PART10- ACCESS CONTROL SPECIFICATIONS – Not use

PART11- COMPILED DETECTION EQUIPMENT LISTING 11.1 Hard-wired

Hard-wired detection equipment shall communicate to the system by way of the control panel loop expansion bus. The equipment shall have a three (3) year warranty as stated in the current DMP Product Catalog and meet or exceed features offered in the following products:

- Motion Detector equal to #C&K 907(hallways) and #C&K 706(classrooms)
- Door Contact DMP Model SD70 (concealed applications – requires DMP zone expander)
- Bus Splitter/Repeater Module DMP Model 710
- Door Contact DMP Model SM20WG (surface applications requires DMP zone expander)
- Output Expansion Module DMP Models 710, 716
- Graphic Annunciator Module DMP Model 717
- 11.3 Power Supplies and Transformers

Power supply, transformer, and battery devices shall maintain system operation. The batteries shall be checked and replaced every three to five years. The equipment shall have a three (3) year warranty as stated in the current DMP Product Catalog and meet or exceed features offered in the following products:

- Power Supply DMP Model 504-24LX, 115 VAC, 24 VDC
- Power Supply DMP Model 505-12, 115 VAC, 12 VDC
- Power Supply DMP Model 505-12LX, 115 VAC, 12 VDC
- Power Supply DMP Model 508, 115 VAC, 12 or 24 VDC

- Transformer DMP Model 326, 16 VAC 50 VA, Wire-in
- Transformer DMP Model 327, 16.5 VAC 50 VA, Plug-in
- Transformer DMP Model 322, 16.5 VAC 56 VA, Wire-in

PART12- INSTALLATION

12.1 System Component Installation

- A. When used in NFPA 72 compliant installations, the Intrusion Detection/ Access Control shall be on an electrical circuit dedicated branch in accordance with the National Electrical Code (NEC) and the local authority having jurisdiction (AHJ). This circuit shall be available only to authorized personnel and shall be clearly labeled "Security Alarm CIRCUIT CONTROL".
- B. Materials shall be installed in strict compliance with all local, state, county, province, district, federal and other applicable building, safety, and fire standards, laws, codes, regulations, and guidelines including, but not limited to, all appendices and amendments and the requirements of the local authority having jurisdiction (AHJ).

C. All wiring from all devices shall be non-spliced home runs.

D. All cables shall be plenum rated.

- E. All conductors from expanders shall be home runs to control panel separately and shall be non spliced.
- F. All conductors terminating at zone splice box shall be identified as per detail device labeling.
- G. All zone splice boxes shall be located per owner's preference.

H. All 120vac shall be provided by contractor to all power supply and panel locations shown or not shown on plans.

I. Install siren in each inside hallway and one outdoor (weather proof).

J. Zone expanders and power supplies shall be installed in each electrical room.

SECTION 28 31 11 ADDRESSABLE FIRE ALARM SYSTEM

PART 1 GENERAL

1.1 RELATED SECTIONS

A. Refer to the electrical sections.

1.2 DESCRIPTION

A. The fire alarm system shall comply with requirements of NFPA Standard 72 for Protected Premises Signaling Systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.

B. The facility shall have an emergency voice alarm communication system. Digitally stored message sequences shall notify the building occupants that a fire or life safety condition has been reported. Message generator(s) shall be capable of automatically distributing up to eight (8) simultaneous, unique messages to appropriate audio zones within the facility based on the type and location of the initiating event. The Fire Command Center (FCC) shall also support Emergency manual voice announcement capability for both system wide or selected audio zones, and shall include provisions for the system operator to override automatic messages system wide or in selected zones.

C. The system shall be support additional, alternate Fire Command Centers, which shall be capable of simultaneous monitoring of all system events. Alternate Fire Command Centers shall also support an approved method of transferring the control functions to an alternate Fire Command Center when necessary. All Fire Command Centers shall be individually capable of assuming Audio Command functions such as Emergency Paging, audio zone control functions, and Firefighter's Telephone communication functions.

D. Each designated zone shall transmit separate and different alarm, supervisory and trouble signals to the Fire Command Center (FCC) and designated personnel in other buildings at the site via a multiplex communication network.

E. The fire alarm system shall be manufactured by an ISO 9001:2008 certified company and meet the requirements of BS EN9001: ANSI/ASQC Q9001-1994

F. The FACP and peripheral devices shall be manufactured 100% by a single U.S. manufacturer (or division thereof). It's acceptable for peripheral devices to be manufactured outside of the U.S. by a division of the U.S. based parent company.

G. The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and the installion shall be in compliance with the UL listing.

H. The installing company shall employ NICET (minimum Level II Fire Alarm Technology) technicians on site to guide the final checkout and to ensure the systems integrity.

- 1.3 SCOPE:
 - 1. A. A new intelligent reporting, microprocessor controlled fire detection system shall be installed in accordance to the project specifications and drawings. Provide labor, materials, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing additional and new devices for new OR existing building. Include all cost in bid for a complete operable code compliant fire alarm system.
 - B. Basic Performance:
 - 1 1. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded on NFPA Style 4 (Class B) Signaling Line Circuits (SLC).
 - 2 2. Device Circuits (IDC) shall be wired Class A (NFPA Style D) as part of an addressable

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device connected by the SLC Circuit.

- 3 3. Notification Appliance Circuits (NAC) shall be wired Class A (NFPA Style Z) as part of an addressable device connected by the SLC Circuit.
- 4 4. On Style 6 or 7 (Class A) configurations a single ground fault or open circuit on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
- 5 5. Alarm signals arriving at the FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.
- 6 6. Speaker circuits may be controlled by NAC outputs built into the amplifiers, which shall function as addressable points on the Digital Audio Loop.
- 7 7. NAC speaker circuits shall be arranged such that there is a minimum of one speaker circuit per floor of the building or smoke zone which ever is greater.
- 8 8. Audio amplifiers and tone generating equipment shall be electrically supervised for normal and abnormal conditions.
- 9 9. NAC speaker circuits and control equipment shall be arranged such that loss of any one (1) speaker circuit will not cause the loss of any other speaker circuit in the system.
- 10 Two-way emergency telephone communication circuits shall be supervised for open and short circuit conditions.
- 11 Speaker circuits shall be arranged such that there is a minimum of one speaker circuit per smoke zone.
- 12 Speaker circuits shall be electrically supervised for open and short circuit conditions. If a short circuit exists on a speaker circuit, it shall not be possible to activate that circuit.
- 13 10. Audio amplifiers and tone generating equipment shall be electrically supervised for abnormal conditions. Digital amplifiers shall provide built-in speaker circuits, field configurable as four Class B (Style Y), or two Class A (Style Z) circuits.
- 14 11. Digital amplifiers shall be capable of storing up to two minutes of digitally recorded audio messages and tones. The digital amplifiers shall also be capable of supervising the connection to the associated digital message generator, and upon loss of that connection shall be capable of one of the following system responses:
 - a. The digital amplifier shall automatically broadcast the stored audio message.
 - b. The digital amplifier shall switch to a mode where a local bus input on the digital amplifier will accept an input to initiate a broadcast of the stored message. This bus input shall be connected to a NAC on a local FACP for the purpose of providing an alternate means of initiating an emergency message during a communication fault condition.
 - 4 c. Speaker circuits shall be either 25 VRMS or 70VRMS. Speaker circuits shall have 20% space capacity for future expansion or increased power output requirements.
 5 d. Two-way emergency telephone (Fire Fighter Telephone) communication shall be
 - d. Two-way emergency telephone (Fire Fighter Telephone) communication shall be supported between the Audio Command Center and up to seven (7) remote Fire Fighter's Telephone locations simultaneously on a telephone riser.
 - e. Means shall be provided to connect FFT voice communications to the speaker circuits in order to allow voice paging over the speaker circuit from a telephone handset.
 - 7 f. The digital audio message generator shall be of reliable, non-moving parts, and support the digital storage of up to 32 minutes of tones and emergency messages, shall support programming options to string audio segments together to create up to 1000 messages, or to loop messages and parts of messages to repeat for pre-determined cycles or indefinitely.

1.4 GUARANTY:

A. The fire alarm control panel, voice panels and any head-end equipment shall have a manufacturer's warranty of a minimum of 3 years.

1.5 QUALIFICATIONS:

A. The fire alarm contractor, as a business entity, shall be an authorized and designated representative of the equipment manufacturer and shall have been actively engaged in the business of selling, installation and servicing fire alarm systems for a period of at least (5) years prior to the bid date.

B. The fire alarm contractor shall have an office within 50 miles of the job site staffed with trained technicians who are qualified to manage the installation, to be responsible that the system is installed as submitted, to conduct system startup, to instruct the project coordinators representatives and local authorities in the proper operation of the system, and to provide service throughout the warranty period. 3. The fire alarm contractor SHALL NOT HAVE any grievances or complaints on record regarding workmanship, code compliance, or service response with either the project coordinator, Architect, Engineer, Owner or the State Fire Marshals office. A contractor that has any prior finding(s) of a Fire Alarm license violation or has any litigation in process with the State Fire Marshal is <u>unacceptable</u>.

3. The fire alarm contractor shall be an active installer on the approved manufacturer for a minimum of 5 years.

1.6 POST CONTRACT MAINTENANCE:

A. Complete maintenance and repair service for the fire detection system shall be available from a factory trained authorized representative of the manufacturer of the major equipment for a period of five (5) years after expiration of the guaranty.

B. As part of the bid/proposal, include a quote for a maintenance contract to provide all maintenance, required tests, and list pricing for any replacement products included on the bill of materials, along with the list pricing for products not on the bill of materials; if test and inspection rates are different than full service rates the bid/proposal shall include pricing for all levels for a minimum period of five (5) years Rates and costs shall be valid for the period of five (5) years after expiration of the guaranty.

C. Include also a quote for unscheduled maintenance/repairs, including hourly rates for technicians trained on this equipment, and response travel costs for each year of the maintenance period. Submittals that do not identify all post contract maintenance costs will not be accepted. Rates and costs shall be valid for the period of five (5) years after expiration of the guaranty.

1.7 APPLICABLE STANDARDS AND SPECIFICATIONS:

A. The specifications and standards listed below form a part of this specification. The system shall fully comply with the latest issue of these standards, if applicable.

No. 12	Extinguishing Systems (low and high)
No. 12A	Halon 1301 Extinguishing Systems
No. 13	Sprinkler Systems
No. 15	Water Spray Systems
No. 16	Foam / Water Deluge and Spray Systems
No. 17	Dry Chemical Extinguishing Systems
No. 17A	Wet Chemical Extinguishing Systems
No. 2001	Clean Agent Extinguishing Systems
No. 70	National Electric Code
No. 90A	Air Conditioning Systems
No. 92A	Smoke Control Systems
No. 92B	Smoke Management Systems in Malls, Atria, Large Areas
No. 72	National Fire Alarm Code
No. 101	Life Safety Code

B. National Fire Protection Association (NFPA) - USA:

C. Underwriters Laboratories Inc. (UL) - USA:

No. 268	Smoke Detectors for Fire Protective Signaling Systems
No. 864	Control Units for Fire Protective Signaling Systems
No. 2572	Mass Notification Systems
No. 217	Smoke Detectors, Single and Multiple Station
No. 228	Door Closers - Holders for Fire Protective Signaling Systems
No. 268A	Smoke Detectors for Duct Applications
No. 521	Heat Detectors for Fire Protective Signaling Systems

No. 464	Audible Signaling Appliances
No. 38	Manually Actuated Signaling Boxes
No. 1481	Power Supplies for Fire Protective Signaling Systems
No. 346	Waterflow Indicators for Fire Protective Signaling Systems
No. 1076	Control Units for Burglar Alarm Proprietary Protective Signaling Systems
No. 1971	Visual Notification Appliances
No. 2017	Standard for General-Purpose Signaling Devices and Systems
No.60950	Safety of Information Technology Equipment

- D. Local and State Building Codes.
- E. All requirements of the Authority Having Jurisdiction (AHJ).

1.8 APPROVALS:

- A. The system shall have proper listing and/or approval from the following nationally recognized agencies:
- UL Underwriters Laboratories, Inc
- ULC Underwriters Laboratories Canada
- FM Factory Mutual
- FM Factory Mutual Gas Detection System
- 6320
- NYFD New York Fire Department
- CSFM California State Fire Marshal

The system shall be listed by the national agencies as suitable for extinguishing release applications. The system shall support release of low pressure CO2.

B. The system shall be certified for seismic applications in accordance with the International Building Code (IBC). For OSHPD applications in California the system shall be Pre-Approved for seismic applications. The basis for qualification of seismic approval shall be via shake table testing.

C. The system shall be approved for Marine Applications and carry the following certifications:

15		
16	1.	USCG United States Coast Guard
17	2.	Lloyd's Register
18	3.	ABS American Bureau of Shipping

D. The System shall be FM 6320 (Factory Mutual) approved as a Gas Detection system when employed with the FMM-4-20 monitor module and industry standard 4-20 mA gas detectors.

1.11 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with NFPA 72 and all contract documents and specification requirements.
- B. All interconnections between this system and the monitoring system shall be arranged so that the entire system can be UL-Certificated.
- C. System shall be a complete, supervised, non-coded, addressable multiplex fire alarm system conforming to NFPA 72.
- D. The system shall have Style 4 circuits for each floor. The system shall operate in the alarm mode upon actuation of any alarm initiating device. The system shall remain in the alarm mode until all initiating device(s) are reset and the fire alarm control panel is manually reset and restored to normal.
- E. The system shall be capable of the following configurations. Both configurations are permitted on the same network.

- 1. The system shall support up to 252 addressable devices, which may be divided in any ratio on one, two, three, or four separate, isolated Class B circuits.
- 2. The system shall support two loops of 252 addressable devices, each of which may be divided in any ratio on one, two, three, or four separate, isolated Class B circuits.
- F. The system shall support H-series devices and Cerberus PRO series devices
- G. The system shall have an optional digital alarm communication transmitter.
- H. The system shall provide an off-normal warning prior to reset for all active devices.
- I. The system shall be capable of remote monitoring via Cerberus Remote, a proprietary software system that provides a graphical representation of the fire alarm control panel at a remote PC when connected via Ethernet to the system. The display will show the exact state of the panel, including blinking LEDs, and with menu buttons for control.
- J. The system shall be capable of being configured via a PC Tool.
- K. In networked systems, each of 4 control panels shall be configurable to be a global annunciator, capable of viewing all other control panels on the network.
- L. The system shall provide the following functions and operating features:
 - 1. The FACP and auxiliary power panels shall provide power, annunciation, supervision and control for the system.
 - 2. Provide Class B initiating device circuits.
 - 3. Provide Style 4 signaling line circuits for the network.
 - 4. Provide two Class B notification appliance circuits. Arrange circuits to allow individual, selective, and visual notification by zone. Notification appliance circuits shall be zoned to correspond with the building fire barriers and other building features.
 - 5. NACs shall be synchronized throughout the entire building.
 - 6. Provide electrical supervision of the primary power (AC) supply, presence of the battery, battery voltage, and placement of system modules within the control panel.
- M. The system shall provide a field test function where one person can test the complete system or a specific area while maintaining full operational function of other areas not being tested. Alarms, supervisory signals, trouble signals shall be logged in system history during the walk-test.
- N. Alarm functions shall override trouble or supervisory functions. Supervisory functions shall override trouble functions.
- O. Fire alarm signal initiation shall be by one or more of the following devices:
 - 1. Manual pull station
 - 2. Heat detector
 - 3. Addressable area smoke detectors
 - 4. Addressable Multi-criteria, dual optical smoke detectors
 - 5. Standard Addressable Duct smoke detector

- 6. Specialized Duct Smoke detector
- 7. Projected beam detector
- 8. Automatic sprinkler system water flow switch.
- P. Activation of any system fire, security, supervisory, trouble, or status initiating device shall cause the following actions and indications at all network Person Machine Interfaces using an LCD display with multiple detail screens.
 - 1. Fire Alarm Condition:
 - 1) Sound an audible alarm and display a custom message defining the building in alarm and the specific alarm point initiating the alarm on an LCD display.
 - 2) Log into the system history archives all activity pertaining to the alarm condition.
 - 3) Sound the ANSI 117-1 signal with synchronized audible notification appliances and synchronized strobes throughout the facility.
 - 4) Audible signals shall be silenced from the fire alarm control panel by an alarm silence switch. Visual signals shall be programmable to flash until system reset or alarm silencing, as required.
 - 5) A signal dedicated to sprinkler system water flow alarm shall not be silenced while the sprinkler system is flowing at a rate of flow equal to a single head.
 - 6) Activation of any smoke detector in a single elevator lobby or an elevator equipment room shall, in addition to the actions described, cause the recall of that bank of elevators to the 1st floor and the lockout of controls. In the event of recall initiation by a detector in the first floor lobby, the recall shall be to the alternate floor as determined by the AHJ.
 - 7) Where indicated on drawings heat detectors in elevator shaft and machine rooms shall activate an elevator power shunt trip breaker. The heat detectors shall be rated at a temperature below the ratings of the sprinkler heads in respective locations to insure that the power shall be shut off before activation of sprinkler system.
 - 8) System operated duct detectors as per local requirements shall accomplish HVAC shut down.
 - 9) Door closure devices shall operate by floor or by local requirements.
 - 2. Supervisory Condition:
 - 1) Display the origin of the supervisory condition report at the local fire alarm control panel LCD display.
 - 2) Activate supervisory audible and dedicated visual signal.
 - 3) Audible signals shall be silenced from the control panel by the supervisory acknowledge switch.
 - 4) Record within system history the initiating device and time of occurrence of the event.
 - 3. Trouble Condition
 - 1) Display at the local fire alarm control panel LCD display, the origin of the trouble condition report.

- 2) Activate trouble audible and visual signals at the control panel and as indicated on the drawings.
- 3) Audible signals shall be silenced from the fire alarm control panel by a trouble acknowledge switch.
- 4) Trouble conditions that have been restored to normal shall be automatically removed from the trouble display queue and not require operator intervention. This feature shall be software selectable and shall not preclude the logging of trouble events to the historical file.
- 5) Trouble reports for primary system power failure to the master control shall be automatically delayed for a period of time equal to 25% of the system standby battery capacity to eliminate spurious reports as a result of power fluctuations.
- 6) Record within system history, the occurrence of the event, the time of occurrence and the device initiating the event.
- Q. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1.11 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories. Complete manufacturer's catalog data including supervisory power usage, alarm power usage, physical dimensions, and finish and mounting requirements.
- B. Power calculations. Battery capacity calculations. Battery size shall be a minimum of 125% of the calculated requirement. Provide the following supporting information:
 - 1. Supervisory power requirements for all equipment.
 - 2. Alarm power requirements for all equipment.
 - 3. Power supply rating justification showing power requirements for each of the system power supplies. Power supplies shall be sized to furnish the total connected load in a worst-case condition plus 25% spare capacity.
 - 4. Voltage drop calculations for wiring runs demonstrating worst-case condition.
 - 5. NAC circuit design shall incorporate a 15% spare capacity for future expansion.
- C. Submit manufacturer's requirements for testing Signaling Line Circuits and device addresses prior to connecting to control panel. At a minimum the following tests shall be required; device address, the usage (Alarm, Supervisory etc), environmental compensation, temperature ratings for thermal detectors and smoke detector sensitivities. This requirement shall need approval before any wiring is connected to the control panel.
- D. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
 - 3. Complete drawings covering the following shall be submitted by the contractor for the proposed system:
 - Floor plans in a CAD compatible format at a scale of 1/8"=1'-0" showing all equipment and raceways, marked for size, conductor count with type and size, showing the percentage of allowable National Electric Code fill used.

- 2) Provide a fire alarm system function matrix as referenced by NFPA 72, Figure A-7-5.2.2 (9). Matrix shall illustrate alarm input/out events in association with initiation devices. Matrix summary shall include system supervisory and trouble output functions. Include any and all departures, exceptions, variances or substitutions from these specifications and/or drawings at time of bid.
- 4. Installation drawings shop drawings, and as-built drawings shall be prepared by an individual experienced with the work specified herein.
- 5. Incomplete submittals shall be returned without review, unless with prior approval of the Engineer.
- E. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Light fixtures.
 - 2. HVAC registers
 - 3. Fire protection equipment interfaces
 - 4. Special suppression system interfaces
- F. Qualification Data: For qualified Installer, Applicator, manufacturer, fabricator, professional engineer, testing agency, and factory-authorized service representative.
- G. Source quality-control reports.
- H. Field quality-control reports.
- I. Operation and Maintenance Data: For all fire alarm equipment, to include in operation and maintenance manuals.
- J. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.
- K. Warranty: Sample of special warranty.

1.11 QUALITY ASSURANCE

- A. Manufacturer Qualifications: The publications listed below form a part of this publication to the extent referenced. The publications are referenced in the text by the basic designation only. The latest version of each listed publication shall be used as a guide unless the authority having jurisdiction has adopted an earlier version.
 - 1. FM Global (Factory Mutual (FM)):FM Approval Guide
 - 2. National Fire Protection Association (NFPA)
 - 1) NFPA 70 National Electrical Code
 - 2) NFPA 72 National Fire Alarm Code
 - 3) NFPA 90A Standard For The Installation of Air Conditioning and Ventilating Systems
- 4) NFPA 101 Life Safety Code
- 3. Underwriters' Laboratories, Inc. (UL) equipment standards, Latest Edition
 - 1) UL Fire Protection Equipment Directory
 - 2) UL Electrical Construction Materials Directory
 - 3) UL 38 Manually Actuated Signaling Boxes for Use With Fire Protection Signaling Systems
 - 4) UL 228 Door Holding Devices
 - 5) UL 268 Smoke Detectors for Fire Protective Signaling Systems
 - 6) UL 268A Smoke Detectors for Duct Application
 - 7) UL 464 Audible Signal Appliances
 - 8) UL 497A Secondary Protectors for Communications Circuits
 - 9) UL 521 Heat Detectors for Fire Protective Signaling Systems
 - 10) UL 864 Control Units for Fire Protective Signaling Systems
 - 11) UL 1283 Electromagnetic Interference Filters
 - 12) UL 1449 Transient Voltage Surge Suppressors
 - 13) UL 1971 Signaling Devices for the Hearing Impaired
 - 14) UL 2075 Gas and Vapor Detectors and Sensors
 - 15) UL 2572 Mass Notification Systems
- 4. International Code Council
 - 1) International Building Code
 - 2) International Fire Code.
- 5. State and Local Building Codes as adopted and/or amended by The Authority Having Jurisdiction, ADA, and/or State and local equivalency standards as adopted by The Authority Having Jurisdiction.
- 6. California State Fire Marshal
- 7. NY-MEA
- 8. The manufacturer shall have a minimum of 15 years production experience in the manufacture and design of high sensitivity aspiration-type smoke detection systems.
- 9. ISO 9002
- B. Supplier Qualifications
 - 1. The manufacturer of the supplied products must utilize multi-channel product distribution on a national basis to be considered for this bid.

- 2. Provide the services of a factory trained and certified representative or technician, experienced in the installation and operation of the type of system provided. The representative shall be licensed in the State if required by law.
- 3. The technician shall supervise installation, software documentation, adjustment, preliminary testing, final testing and certification of the system. The technician shall provide the required instruction to the owner's personnel in the system operation and maintenance.
- 4. The suppliers shall furnish evidence they have an experienced service organization, which carries a stock of spare and repair parts for the system being furnished.
- 5. The equipment supplier shall be authorized and trained by the manufacturer to calculate, design, install, test, and maintain the air sampling system and shall be able to produce a certificate stating such upon request.
- C. Installer Qualifications:
 - 1. Before commencing work, submit data showing that the manufacturer has successfully installed fire alarm systems of the same scope, type and design as specified.
 - 2. The contractor shall submit copies of all required Licenses and Bonds as required in the State having jurisdiction.
 - 3. The contractor shall employ on staff a minimum of one NICET level II technician or a professional engineer, registered in the State of the installation.
 - 4. The contractor shall be qualified by UL for certifying fire alarm systems.
 - 5. Contractors unable to comply with the provisions of Qualification of Installers shall present proof of engaging the services of a subcontractor qualified to furnish the required services.
 - 6. The fire alarm contractor as a business entity shall be an authorized and designated representative of the equipment manufacturer and shall have been actively engaged in the business of selling, installation and serving fire alarm systems for a period of at least (5) years prior to bid date.
 - 7. The fire alarm contractor shall have an office within 50 miles of the job site staffed with trained technicians who are qualified to manage the installation, to be responsible that the system is installed as submitted, to conduct system start-up, to instruct the project coordinators representatives and local authorities in the proper operation of the system and to provide service throughout the warranty period.
 - 8. The fire alarm contractor SHALL NOT HAVE any grievances or complaints on record regarding workmanship code compliance or service response with either the project coordinator Engineer, Owner or the State Fire Marshals office. A contract that any prior findings of a Fire Alarm license violation or has any litigation in process with the State Fire Marshall is UNACCEPTABLE.
 - 9. The fire alarm contractor shall be an active installer on the approved manufacturer for a minimum of 5 years.

PART 2.0 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

1. Basis of Design - Notifier

2. If equipment of another manufacturer is to be submitted for approval as equal, the contractor shall list all exceptions taken to these specifications, all variances from these specifications and all substitutions of operating

capabilities or equipment called for in these specifications and forward said list to Engineer ten (10) days prior to bid. Any such exception, variances or substitutions that were not listed at the time of bid and are identified in the submittal, shall be grounds for immediate disapproval without comment. Final determination with this specification shall rest with the Engineer, who at his discretion may require proof of performance.

3. Other acceptable manufacturers: Silent Knight 6820 EVS - Voice Evac system and Siemens

MAIN FIRE ALARM CONTROL PANEL OR NETWORK NODE:

A. Main FACP or network node shall contain a microprocessor based Central Processing Unit (CPU) and power supply. The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, printer, annunciators, and other system controlled devices.

B. In conjunction with intelligent Loop Control Modules and Loop Expander Modules, the main FACP shall perform the following functions:

1. Supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.

2. Supervise all initiating signaling and notification circuits throughout the facility by way of connection to addressable monitor and control modules.

3. Detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed. In the event of CPU failure, all SLC loop modules shall fallback to degrade mode. Such degrade mode shall treat the corresponding SLC loop control modules and associated detection devices as conventional two-wire operation. Any activation of a detector in this mode shall automatically activate associated Notification Appliance Circuits.

2.2 SYSTEM CAPACITY AND GENERAL OPERATION

A. The FACP shall be capable of communicating on Noti-Fire-Net over a Local Area Network (LAN) or Wide Area Network (WAN) utilizing a peer-to-peer, inherently regenerative communication format and protocol. The network shall support communication speed up to 100 Mb and support up to 200 panels / nodes per network.

B. The control panel shall be capable of expansion via up to 10 SLC loops. Each module shall support up to 318 analog/addressable devices for a maximum system capacity of 3180 points. The Fire Alarm Control Panel shall include a full featured operator interface control and annunciation panel that shall include a backlit 640-character liquid crystal display, individual, color coded system status LEDs, and a keypad for the control of the fire alarm system. Said LCD shall also support graphic bit maps capable of displaying the company name and logo of either thpany.

C. All programming or editing of the existing program in the system shall be achieved without interrupting the alarm monitoring functions of the fire alarm control panel.

D. The FACP shall be able to provide the following software and hardware features:

1. Pre-signal and Positive Alarm Sequence: The system shall provide means to cause alarm signals to only sound in specific areas with a delay of the alarm from 60 to up to 180 seconds after start of alarm processing. In addition, a Positive Alarm Sequence selection shall be available that allows a 15-second time period for acknowledging an alarm signal from a fire detection/initiating device. If the alarm is not acknowledged within 15 seconds, all local and remote outputs shall automatically activate immediately.

2. Smoke Detector Pre-alarm Indication at Control Panel: To obtain early warning of incipient or potential fire conditions, the system shall support a programmable option to determine system response to real-time detector sensing values above the programmed setting. Two levels of Pre-alarm indication shall be available at the control panel: alert and action.

3. Alert: It shall be possible to set individual smoke detectors for pre-programmed pre-alarm thresholds. If the individual threshold is reached, the pre-alarm condition shall be activated.

4. Action: If programmed for Action and the detector reaches a level exceeding the preprogrammed level, the control panel shall indicate an action condition. Sounder bases installed with either heat or smoke detectors shall automatically activate on action Pre-Alarm level, with general evacuation on Alarm level.

5. The system shall support a detector response time to meet world annunciation requirements of less than 3 seconds.

6. Device Blink Control: Means shall be provided to turn off detector/module LED strobes for special areas.

7. NFPA 72 Smoke Detector Sensitivity Test: The system shall provide an automatic smoke detector test function that meets the sensitivity testing requirements of NFPA 72.

8. Programmable Trouble Reminder: The system shall provide means to automatically initiate a reminder that troubles exist in the system. The reminder will appear on the system display and (if enabled) will sound a piezo alarm.

9. On-line or Off-line programming: The system shall provide means to allow panel programming either through an off-line software utility program away from the panel or while connected and on-line. The system shall also support upload and download of programmed database and panel executive system program to a Personal Computer/laptop. A single change to one CPU database shall not require a database download to other CPUs.

10. History Events: The panel shall maintain a history file of the last 4000 events, each with a time and date stamp. History events shall include all alarms, troubles, operator actions, and programming entries. The control panels shall also maintain a 1000 event Alarm History buffer, which consists of the 1000 most recent alarm events from the 4000 event history file.

11. Smoke Control Modes: The system shall provide means to perform FSCS mode Smoke Control to meet NFPA-92A and 90B and HVAC mode to meet NFPA 90A.

12. The system shall provide means for all SLC devices on any SLC loop to be auto programmed into the system by specific address. The system shall recognize specific device type ID's and associate that ID with the corresponding address of the device.

13. Passwords and Users: The system shall support two password levels, master and user. Up to 9 user passwords shall be available, each of which may be assigned access to the programming change menus, the alter status menus, or both. Only the master password shall allow access to password change screens.

14. Block Acknowledge: The system shall support a block Acknowledge for Trouble Conditions

15. Sensitivity Adjust: The system shall provide Automatic Detector Sensitivity Adjust based on Occupancy schedules including a Holiday list of up to 15 days.

16. Environmental Drift Control: The system shall provide means for setting Environmental Drift Compensation by device. When a detector accumulates dust in the chamber and reaches an unacceptable level but yet still below the allowed limit, the control panel shall indicate a maintenance alert warning. When the detector accumulates dust in the chamber above the allowed limit, the control panel shall indicate a maintenance urgent warning.

17. Custom Action Messages: The system shall provide means to enter up to 100 custom action messages of up to 160 characters each. It shall be possible to assign any of the 100 messages to any point.

18. Local Mode: If communication is lost to the central processor the system shall provide added survivability through the intelligent loop control modules. Inputs from devices connected to the SLC and loop control modules shall activate outputs on the same loop when the inputs and outputs have been set with point programming to participate in local mode or when the type codes are of the same type: that is, an input with a fire alarm type code shall activate an output with a fire alarm type code.

19. Read status preview - enabled and disabled points: Prior to re-enabling points, the system shall inform the user that a disabled device is in the alarm state. This shall provide notice that the device must be reset before the device is enabled thereby avoiding activation of the notification circuits.

20. Custom Graphics: When fitted with an LCD display, the panel shall permit uploading of a custom bit-mapped graphic to the display screen.

21. Multi-Detector and Cooperating Detectors: The system shall provide means to link one detector with up to two detectors at other addresses on the same loop in cooperative multi-detector sensing. There shall be no requirement for sequential addresses on the detectors and the alarm event shall be a result of all cooperating detectors chamber readings.

22. ACTIVE EVENT: The system shall provide a Type ID called FIRE CONTROL for purposes of air-handling shutdown, which shall be intended to override normal operating automatic

functions. Activation of a FIRE CONTROL point shall cause the control panel to (1) initiate the monitor module Control-by-Event, (2) send a message to the panel display, history buffer, installed printer and annunciators, (3) shall not light an indicator at the control panel, (4) Shall display ACTIVE on the LCD as well a display a FIRE CONTROL Type Code and other information specific to the device.

23. NON-FIRE Alarm Module Reporting: A point with a type ID of NON-FIRE shall be available for use for energy management or other non-fire situations. NON-FIRE point operation shall not affect control panel operation nor shall it display a message at the panel LDC. Activation of a NON-FIRE point shall activate control by event logic but shall not cause any indication on the control panel.

24. Mass Notification Override: The system shall be UL 2572 listed for Mass Notification and shall be capable, based on the Risk Analysis, of being programmed so that Mass Notification/Emergency Communications events take precedence over fire alarm events.

25. Security Monitor Points: The system shall provide means to monitor any point as a type security.

26. One-Man Walk Test: The system shall provide both a basic and advanced walk test for testing the entire fire alarm system. The basic walk test shall allow a single operator to run audible tests on the panel. All logic equation automation shall be suspended during the test and while annunciators can be enabled for the test, all shall default to the disabled state. During an advanced walk test, field-supplied output point programming will react to input stimuli such as CBE and logic equations. When points are activated in advanced test mode, each initiating event shall latch the input. The advanced test shall be audible and shall be used for pull station verification, magnet activated tests on input devices, input and output device and wiring operation/verification.

27. Control By Event Functions: CBE software functions shall provide means to program a variety of output responses based on various initiating events. The control panel shall operate CBE through lists of zones. A zone shall become listed when it is added to a point's zone map through point programming. Each input point such as detector, monitor module or panel circuit module shall support listing of up to 10 zones into its programmed zone map.

28. Permitted zone types shall be general zone, releasing zone and special zone. Each output point (control module, panel circuit module) can support a list of up to 10 zones including general zone, logic zone, releasing zone and trouble zone. It shall be possible for output points to be assigned to list general alarm. Non-Alarm or Supervisory points shall not activate the general alarm zone.

29. 1000 General Zones: The system shall support up to 1000 general purpose software zones for linking inputs to outputs. When an input device activates, any general zone programmed into that device's zone map will be active and any output device that has an active general zone in its map will be active. It shall also be possible to use general zone as arguments in logic equations.

30. 1000 Logic Equations: The system shall support up to 1000 logic equations for AND, OR, NOT, ONLY1, ANYX, XZONE or RANGE operators that allow conditional I/O linking. When any logic equation becomes true, all output points mapped to the logic zone shall activate.

31. 100 trouble equations per device: The system shall provide support for up to 100 trouble equations for each device, which shall permit programming parameters to be altered, based on specific fault conditions. If the trouble equation becomes true, all output points mapped to the trouble zone shall activate.

32. Control-By-Time: A time based logic function shall be available to delay an action for a specific period of time based upon a logic input with tracking feature. A latched version shall also be available. Another version of this shall permit activation on specific days of the week or year with ability to set and restore based on a 24 hour time schedule on any day of the week or year.

33. Multiple agent releasing zones: The system shall support up to 10 releasing zones to protect against 10 independent hazards. Releasing zones shall provide up to three cross-zone and four abort options to satisfy any local jurisdiction requirements.

34. Alarm Verification, by device, with timer and tally: The system shall provide a user-defined global software timer function that can be set for a specific detector. The timer function shall delay an alarm signal for a user-specified time period and the control panel shall ignore the alarm verification timer if another alarm is detected during the verification period. It shall also be possible to set a maximum verification count between 0 and 20 with the "0" setting producing no alarm verification. When the counter exceeds the threshold value entered, a trouble shall be generated to the panel.

E. Network Communication

1. The FACP shall be capable of communicating on Noti-Fire-Net over a Local Area Network (LAN) or Wide Area Network (WAN) utilizing a peer-to-peer, inherently regenerative communication format and protocol. The network shall support communication speed up to 100 Mb and support up to 200 panels/nodes per network.

F. Central Processing Unit

1. The Central Processing Unit shall contain and execute all control-by-event (including Boolean functions including but not limited to AND, OR, NOT, ANYx, and CROSSZONE) programs for specific action to be taken if an alarm condition is detected by the system. Such control-by-event programs shall be held in non-volatile programmable memory, and shall not be lost with system primary and secondary power failure.

2. The Central Processing Unit shall also provide a real-time clock for time annotation, to the second, of all system events. The time-of-day and date shall not be lost if system primary and secondary power supplies fail.

3. The CPU shall be capable of being programmed on site without requiring the use of any external programming equipment. Systems that require the use of external programmers or change of EPROMs are not acceptable.

4. The CPU shall provide an EIA-232 interface between the fire alarm control panel and the UL Listed Electronic Data Processing (EDP) peripherals.

5. The CPU shall provide two EIA-485 ports for the serial connection to annunciation and control subsystem components.

6. The EIA-232 serial output circuit shall be optically isolated to assure protection from earth ground.

G. Display

1. The system display shall provide a 640-character backlit alphanumeric Liquid Crystal Display (LCD). It shall also provide eleven Light-Emitting-Diodes (LEDs) that indicate the status of the following system parameters: AC POWER, FIRE ALARM, PREALARM, SECURITY, SUPERVISORY, SYSTEM TROUBLE, OTHER EVENT, SIGNALS SILENCED, POINT DISABLED, CONTROLS ACTIVE, and CPU FAILURE.

2. The system display shall provide a keypad with control capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels with up to ten (one Master and nine User) passwords shall be accessible through the display interface assembly to prevent unauthorized system control or programming.

H. Loop (Signaling Line Circuit) Control Module:

1. The Loop Control Module shall monitor and control a minimum of 318 intelligent addressable devices. This includes 159 intelligent detectors (Ionization, Photoelectric, or Thermal) and 159monitor or control modules.

2. The Loop Control Module shall contain its own microprocessor and shall be capable of operating in a local/degrade mode (any addressable device input shall be capable of activating any or all addressable device outputs) in the unlikely event of a failure in the main CPU.

3. Each Loop shall be capable of operating as a NFPA Style 4 (Class B) circuit.

4. The SLC interface board shall receive analog or digital information from all intelligent detectors and shall process this information to determine whether normal, alarm, or trouble conditions exist for that particular device. Each SLC Loop shall be isolated and equipped to annunciate an Earth Fault condition. The SLC interface board software shall include software to 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 may also be used for automatic detector testing and the automatic determination of detector maintenance requirements.

I. Digital Voice Command Center

1. The Digital Voice Command Center located with the FACP, shall contain all equipment required for all audio control, emergency telephone system control, signaling and supervisory functions. This shall include speaker zone indication and control, telephone circuit indication and control, digital voice units, microphone and main telephone handset.

2. Function: The Voice Command Center equipment shall perform the following functions:

a. Operate as a supervised multi-channel emergency voice communication system. Operate as a two-way emergency telephone system control center.

b. Audibly and visually annunciate the active or trouble condition of every speaker circuit and emergency telephone circuit.

c. Audibly and visually annunciate any trouble condition for digital tone and voice units required for normal operation of the system.

d. Provide all-call Emergency Paging activities through activation of a single control switch.

e. As required, provide vectored paging control to specific audio zones via dedicated control switches.

f. Provide a factory recorded "library" of voice messages and tones in standard WAV. File format, which may be edited and saved on a PC running a current Windows® operating system.

g. Provide a software utility capable of off-line programming for the DVC operation and the audio message files. This utility shall support the creation of new programs as well as editing and saving existing program files. Uploading or downloading the DVC shall not inhibit the emergency operation of other nodes on the fire alarm network.

h. Support an optional mode of operation with four analog audio outputs capable of being used with UL 864 fire-listed analog audio amplifiers and SLC controlled switching.

i. The Digital Voice Command shall be modular in construction, and shall be capable of being field programmable without requiring the return of any components to the manufacturer and without requiring use of any external computers or other programming equipment.

j. The Digital Voice Command and associated equipment shall be protected against unusually high voltage surges or line transients.

J. Power Supply:

1. The Main Power Supply shall operate on 120/240 VAC, 50/60 Hz, and shall provide all necessary power for the FACP.

2. The Main Power Supply shall provide the required power to the CPU using a switching 24 VDC regulator and shall incorporate a battery charger for 24 hours of standby power using dual-rate charging techniques for fast battery recharge.

3. The Main Power Supply shall provide a battery charger for 24 hours of standby using dual-rate charging techniques for fast battery recharge. The supply shall be capable of charging batteries ranging in capacity from 7-200 amp-hours within a 48-hour period.

4. The Main Power Supply shall provide a very low frequency sweep earth detect circuit, capable of detecting earth faults.

5. The Main Power Supply shall be power-limited per UL864 requirements.

6. The Main Power Supply shall communicate power supply, line voltage, battery status and charger status to the local LCD display. Any abnormal condition shall be annunicated and logged to the system alarm history log.

7. Addressable Charger Power SupplyThe auxiliary addressable power supply is a remote 24 VDC power supply used to power Notification Devices and field devices that require regulated 24 VDC power.

8. The addressable power supply for the fire detection system shall provide up to a minimum of 6.0 amps of 24 volt DC regulated power for Notification Appliance Circuit (NAC) power or 10.0 amps of 24 volt DC general power. The power supply shall have an additional 0.5 amp of 24 VDC auxiliary power for use within the same cabinet as the power supply. It shall include an integral charger designed to charge 12 - 200 amp hour batteries.

9. The addressable power supply shall provide four individually addressable Notification Appliance Circuits that may be configured as Class "A" or Class "B" circuits. All circuits shall be power-limited per UL 864 requirements.

10. The addressable power supply shall provide built-in synchronization for certain Notification Appliances on each circuit without the need for additional synchronization modules. The power supply's output circuits shall be individually selected for synchronization. A single addressable power supply shall be capable of supporting both synchronized and non-synchronized Notification Devices at the same time.

11. The addressable power supply shall operate on 120 or 240 VAC, 50/60 Hz.

12. The interface to the power supply from the Fire Alarm Control Panel (FACP) shall be via the Signaling Line Circuit (SLC) or other multiplexed means Power supplies that do not use an intelligent interface are not suitable substitutes. The required wiring from the FACP to the addressable power supply shall be a single unshielded twisted pair wire.

13. The addressable power supply shall supervise for battery charging failure, AC power loss, power brownout, battery failure, NAC loss, and optional ground fault detection. In the event of a trouble condition, the addressable power supply shall report the incident and the applicable address to the FACP via the SLC.

14. The addressable power supply shall have an AC Power Loss Delay option. If this option is utilized and the addressable power supply experiences an AC power loss, reporting of the incident to the FACP will be delayed. A delay time of zero, two, eight or sixteen hours shall be programmable.

15. The addressable power supply shall have an option for Canadian Trouble Reporting and this option shall be programmable.

16. The addressable power supply mounts in either the FACP backbox or it's own dedicated surface mounted backbox with cover.

17. Each of the power supply's four output circuits shall be programmed- for Notification Appliance Circuit or General Purpose 24 VDC power. Any output circuit shall be able to provide up to 2.5 amps of 24 VDC power.

18. The addressable power supply's output circuits shall be individually supervised when they are selected to be either a Notification Appliance Circuit when wired Class "A" or by the use of and end-of-line resistor. When the power supply's output circuit is selected as General 24 VDC power, the circuit shall be individually supervised when an end-of-line relay is used.

19. When selected for Notification Appliance Circuits, the output circuits shall be individually programmable for Steady, March Time, Dual Stage or Temporal.

20. When selected as a Notification Appliance Circuit, the output circuits of the addressable power supply shall have the option to be coded by the use of a universal zone coder.

21. The addressable power supply shall interface and synchronize with other power supplies of the same type. The required wiring to interface multiple addressable power supplies shall be a single unshielded, twisted pair wire.

22. An individual or multiple interfaced addressable power supplies shall have the option to use an external charger for battery charging. Interfaced power supplies shall have the option to share backup battery power.

K. Audio Amplifiers

1. The Audio Amplifiers will provide Audio Power () for distribution to speaker circuits.

2. Multiple audio amplifiers may be mounted in a single enclosure, either to supply incremental audio power, or to function as an automatically switched backup amplifier(s).

3. The audio amplifier shall include an integral power supply, and shall provide built-in LED indicators for the following conditions:

- a. Earth Fault on DAP A (Digital Audio Port A)
- b. Earth Fault on DAP B (Digital Audio Port B)
- c. Audio Amplifier Failure Detected Trouble
- d. Active Alarm Bus input
- e. Audio Detected on Aux Input A
- f. Audio Detected on Aux Input B
- g. Audio Detected on Firefighter's Telephone Riser
- h. Receiving Audio from digital audio riser
- i. Short circuit on speaker circuit 1
- j. Short circuit on speaker circuit 2
- k. Short circuit on speaker circuit 3

- 1. Short circuit on speaker circuit 4
- m. Data Transmitted on DAP A
- n. Data Received on DAP A
- o. Data Transmitted on DAP B
- p. Data Received on DAP B
- q. Board failure
- r. Active fiber optic media connection on port A (fiber optic media applications)
- s. Active fiber optic media connection on port B (fiber optic media applications)
- t. Power supply Earth Fault
- u. Power supply 5V present
- v. Power supply conditions Brownout, High Battery, Low Battery, Charger Trouble
- 4. The audio amplifier shall provide the following built-in controls:
 - a. Amplifier Address Selection Switches
 - b. Signal Silence of communication loss annunciation Reset
 - c. Level adjustment for background music
 - d. Enable/Disable for Earth Fault detection on DAP A
 - e. Enable/Disable for Earth Fault detection on DAP A
 - f. Switch for 2-wire/4-wire FFT riser

5. Adjustment of the correct audio level for the amplifier shall not require any special tools or test equipment.

6. Includes audio input and amplified output supervision, back up input, and automatic switch over function, (if primary amplifier should fail).

7. System shall be capable of backing up digital amplifiers.

8. One-to-one backup shall be provided by either a plug-in amplifier card or a designated backup amplifier of identical model as the primary amplifier.

9. One designated backup amplifier shall be capable of backing up multiple primary amplifiers mounted in the same or adjacent cabinets.

10. Multi-channel operation from a single amplifier shall be supported by the addition of an optional plug-in amplifier card.

L. Audio Message Generator (Prerecorded Voice)/Speaker Control:

1. Each initiating zone or intelligent device shall interface with an emergency voice communication system capable of transmitting a prerecorded voice message to all speakers in the building.

2. Actuation of any alarm initiating device shall cause a prerecorded message to sound over the speakers. The message shall be repeated four (4) times. Pre- and post-message tones shall be supported.

- 3. A built-in microphone shall be provided to allow paging through speaker circuits.
- 4. System paging from emergency telephone circuits shall be supported.

5. The audio message generator shall have the following indicators and controls to allow for proper operator understanding and control:

- a. Lamp Test
- b. Trouble
- c. Off-Line Trouble
- d. Microphone Trouble
- e. Phone Trouble
- f. Busy/Wait
- g. Page Inhibited
- h. Pre/Post Announcement Tone
- M. Controls with associated LED Indicators:
 - 1. Speaker Switches/Indicators

a. The speaker circuit control switches/indicators shall include visual indication of active and trouble status for each speaker circuit in the system.

b. The speaker circuit control panel shall include switches to manually activate or deactivate each speaker circuit in the system. $\$

2. Emergency Two-Way Telephone Control Switches/Indicators

a. The emergency telephone circuit control panel shall include visual indication of active and trouble status for each telephone circuit in the system.

b. The telephone circuit control panel shall include switches to manually activate or deactivate each telephone circuit in the system.

N. Remote Transmissions:

1. Provide local energy or polarity reversal or trip circuits as required.

2. The system shall be capable of operating a polarity reversal or local energy or fire alarm transmitter for automatically transmitting fire information to the fire department.

3. Provide capability and equipment for transmission of zone alarm and trouble signals to remote operator's terminals, system printers and annunciators.

4. Transmitters shall be compatible with the systems and equipment they are connected to such as timing, operation and other required features.

O. Field Programming

1. The system shall be programmable, configurable and expandable in the field without the need for special tools, laptop computers, or other electronic interface equipment. There shall be no firmware changes required to field modify the system time, point information, equations, or annunciator programming/information.

2. All field defined programs shall be stored in non-volatile memory.

P. Specific System Operations

1. Smoke Detector Sensitivity Adjust: A means shall be provided for adjusting the sensitivity of any or all addressable intelligent detectors in the system from the system keypad. Sensitivity range shall be within the allowed UL window and have a minimum of 9 levels.

2. Alarm Verification: Each of the intelligent addressable smoke detectors in the system may be independently selected and enabled to be an alarm verified detector. The alarm verification delay shall be programmable from 0 to 60 seconds and each detector shall be able to be selected for verification. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.

Q. System Point Operations:

1. Any addressable device in the system shall have the capability to be enabled or disabled through the system keypad or video terminal.

2. System output points shall be capable of being turned on or off from the system keypad or the video terminal.

3. Point Read: The system shall be able to display the following point status diagnostic functions without the need for peripheral equipment. Each point shall be annunciated for the parameters listed:

- 1 a. Device Status.
- 2 b. Device Type.
- 3 c. Custom Device Label.
- 4 d. Software Zone Label.
- 5 e. Device Zone Assignments.
- 6 f. Analog Detector Sensitivity.
- 7 g. All Program Parameters.

4. System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 4000 system events. Each of these events will be stored, with time and date stamp, until an operator requests that the contents be either displayed or printed. The contents of the history buffer may be manually reviewed; one event at a time, and the actual number of activations may also be displayed and or printed. History events shall include all alarms, troubles, operator actions, and programming entries.

5. The history buffer shall use non-volatile memory. Systems which use volatile memory for history storage are not acceptable.

6. Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent system detector and shall analyze the detector responses over a period of time.

7. If any intelligent detector in the system responds with a reading that is below or above normal limits, then the system will enter the trouble mode, and the particular Intelligent Detector will be annunciated on the system display, and printed on the optional system printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.

8. The system shall include the ability (programmable) to indicate a "pre-alarm" condition. This will be used to alert maintenance personal when a detector is at 80% of its alarm threshold in a 60 second period.

2.3 SYSTEM COMPONENTS:

- A. Conventional Aspirating Detection
 - 1. An optional air aspiration detection system shall be available.
 - 2. The aspirating system shall support multiple sensitivity settings.
 - 3. The aspirating system shall operate from 24 VDC.

4. The aspirating system shall provide alarm and trouble relays used to activate a fire alarm control panel.

B. Aspiration System Interface:

1. The system shall be capable of supporting Interface Modules for integrating Vesda Aspiration detectors into SLC loop of the fire alarm control panel. The Interface Module shall support up to 19 detectors detectors, each SLC loop shall support one interface module.

C. High Level Aspiration System Interface:

1. The system shall be capable of supporting a High Level Interface for Vesda Aspirating Detection Systems. The interface shall support up to 100 detectors and allow the fire alarm network to monitor and control events on the aspiration system.

D. Portable Emergency Telephone Handset Jack

 Portable emergency telephone handset jacks shall be flush mounted on stainless steel plates as indicated on plans. Handset jacks shall be approved for emergency telephone system application.
 Insertion of a remote handset plug into a jack shall send a signal to the fire command center which shall audibly and visually indicate the on-line condition, and shall sound a ring indication in the handset.

3. The two-way emergency telephone system shall support a minimum of seven (7) handsets on line without degradation of the signal.

E. Fixed Emergency Telephone Handset

1. The telephone cabinet shall be painted red and clearly labeled emergency telephone. The cabinets shall be located where shown on drawings.

2. The handset cradle shall have a switch connection such that lifting the handset off of the cradle shall send a signal to the fire command center which shall audibly and visually indicate its on-line (off-hook) condition.

3. The two-way emergency telephone system shall support a maximum of seven (7) handsets on line (off hook) without degradation of the signal.

F. Universal Digital Alarm Communicator Transmitter (UDACT). The UDACT is an interface for communicating digital information between a fire alarm control panel and an UL-Listed central station.

1. The UDACT shall be compact in size, mounting in a standard module position of the fire alarm control cabinet. Optionally, the UDACT shall have the ability for remote mounting, up to 6,000 feet from the fire alarm control panel. The wire connections between the UDACT and the control panel shall be supervised with one pair for power and one pair for multiplexed communication of overall system status. Systems that utilize relay contact closures are not acceptable.

2. The UDACT shall include connections for dual telephone lines (with voltage detect), per UL/NFPA/FCC requirements. It shall include the ability for split reporting of panel events up to two different telephone numbers.

- 3. The UDACT shall be capable of transmitting events in 4+2, SIA, and Contact ID.
- 4. Communication shall include vital system status such as:
- 9 a. Independent Zone (Alarm, trouble, non-alarm, supervisory)
- 10 b. Independent Addressable Device Status
- 11 c. AC (Mains) Power Loss
- 12 d. Low Battery and Earth Fault
- 13 e. System Off Normal
- 14 f. 12 and 24 Hour Test Signal
- 15 g. Abnormal Test Signal (per UL requirements)
- 16 h. EIA-485 Communications Failure
- 17 i. Phone Line Failure
- 18

5. The UDACT shall support independent zone/point reporting when used in the Contact ID format. In this format the UDACT shall support transmission of up to 3,064 points. This enables the central station to have exact details concerning the origin of the fire or response emergency.

6. The UDACT shall be capable of being programmed with the same programming utility as the host FACP, and saved, edited and uploaded and downloaded using the utility. UDACT shall be capable of being programmed online or offline. The programming utility shall also support upgrading UDACT operating firmware.

7. The UDACT shall be capable of generating Central Station reports providing detailed programming information for each point along with the central station point address.

8. An IP or IP/GSM Communicator option shall be available to interface to the UDACT and be capable of transmitting signals over the internet/intranet or Cellular (GSM) network to a compatible receiver.

G. Field Wiring Terminal Blocks

1. For ease of service all panel I/O wiring terminal blocks shall be removable, plug-in types and have sufficient capacity for #18 to #12 AWG wire. Terminal blocks that are permanently fixed are not acceptable.

H. Printer

1. The printer shall provide hard-copy printout of all changes in status of the system and shall time-stamp such printouts with the current time-of-day and date. The printer shall be standard carriage with 80-characters per line and shall use standard pin-feed paper. The printer shall be enclosed in a separate cabinet suitable for placement on a desktop or table. The printer shall communicate with the control panel using an interface complying with Electrical Industries Association standard EIA-232D. Power to the printer shall be 120 VAC @ 60 Hz.

2. The system shall have a strip printer capable of being mounted directly in the main FACP enclosure. Alarms shall be printed in easy-to-read RED, other messages, such as a trouble, shall be printed in BLACK. This printer shall receive power from the system power supply and shall operate via battery back-up if AC mains are lost. The strip printer shall be UL 864 listed.

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printed in BLACK. This printer shall receive power from the system power supply and shall operate via battery back-up if AC mains are lost. The strip printer shall be UL 864 listed.

I. Smoke Control Annunciator

1. On/Auto/Off switches and status indicators (LEDS) shall be provided for monitoring and manual control of each fan, damper, HVAC control unit, stairwell pressurization fan, and smoke exhaust fan. To ensure compliance the units supplied shall meet the following UL categories: UUKL, PAZX, UDTZ, QVAX as well as the requirements of NFPA 90A, HVAC, and NFPA 92A & 92B, Smoke Control. The control System shall be field programmable for either 90A operation or 92A/B operation to allow for future use and system expansion.

2. The OFF LED shall be Yellow, the ON LED shall be green, the Trouble/Fault LED shall be Amber/Orange for each switch. The Trouble/Fault indicator shall indicate a trouble in the control and/or monitor points associated with that switch. In addition, each group of eight switches shall have two LEDS and one momentary switch which allow the following functions: An Amber LED to indicate an OFF-NORMAL switch position, in the ON or OFF position; A Green LED to indicate ALL AUTO switch position; A Local Acknowledge/Lamp Test momentary switch.

3. Each switch shall have the capability to monitor and control two addressable inputs and two addressable outputs. In all modes, the ON and OFF indicators shall continuously follow the device status not the switch position. Positive feedback shall be employed to verify correct operation of the device being controlled. Systems that indicate on/off/auto by physical switch position only are not acceptable.

4. All HVAC switches (i.e., limit switches, vane switches, etc.) shall be provided and installed by the HVAC contractor.

5. It shall be possible to meet the requirements mentioned above utilizing wall mounted custom graphic.

2.4 GATEWAY & WEBSERVER OPTIONS

A. Common Alerting Protocol (CAP) Gateway: The system shall support an optional CAP Gateway (Common Alerting Protocol). The CAP Gateway translates fire system messages to industry standard CAP messages for integration with CAP-compliant clients. A CAP gateway shall be available from the fire alarm control panel manufacturer.

B. LEDSIGN Gateway: The system shall support an optional and proprietary LEDSIGN Gateway to interface to LED signs that will automatically display emergency messages. The signs shall be capable of storing up to 100 messages that can be activated via system programming with the ability to be manually overridden. The Sign Gateway shall support up to 10 independent signs, each sign capable of playing an independent message. Multiple LEDSIGN Gateways can be used in network applications. An LEDSIGN gateway shall be available from the fire alarm control panel manufacturer.

C. BACnet Interface Gateway: The system shall be capable of being interfaced with BACNet compliant clients. A BACnet interface supporting BACnet/IP communication shall be available from the fire alarm control panel manufacturer.

D. MODbus Interface Gateway: The system shall be capable of being interfaced with MODbus compliant clients. A MODbus interface supporting MODbus/TCP communication shall be available from the fire alarm control panel manufacturer.

E. Noti-Fire-Net Gateway: The system shall support an IP based gateway to enable the panel or local Noti-Fire-Net to be connected to an ONYXWorks workstation via the Internet or Intranet. This gateway shall also support the ability to integrate the system to an interactive firefighter's display. The Noti-Fire-Net Gateway shall be available from the fire alarm control manufacturer.

F. Webserver: The system shall support a webserver allowing remote connection via the Internet or Intranet. Authorized users will have the ability to view panel/network history, event status and device properties. The webserver shall also support sending event information via email or text to up to 50 registered users, the webserver shall be available from the fire alarm control panel manufacturer. G. Web Portal Interface: The system shall be capable of being interfaced with a web portal to integrate with Inspection and Service Manager utilities. The web portal and inspection and service manager utilities shall be available from the fire alarm control panel manufacturer.

2.5 SYSTEM COMPONENTS - ADDRESSABLE DEVICES

A. Addressable Devices – General

1. Addressable devices shall provide an address-setting means using rotary decimal switches. Addressable devices that require the address be programmed using a programming utility are not an allowable substitute.

2. Addressable devices shall use simple to install and maintain decade, decimal address switches. Devices shall be capable of being set to an address in a range of 001 to 159.

3. Addressable devices, which use a binary-coded address setting method, such as a DIP-switch, are not an allowable substitute. Addressable devices that require the address be programmed using a special tool or programming utility are not an allowable substitute.

4. Addressable devices, which use a binary-coded address setting method, such as a DIP-switch, are not an allowable substitute. Addressable devices that require the address be programmed using a special tool or programming utility are not an allowable substitute.

5. Detectors shall be intelligent (analog) and addressable, and shall connect with two wires to the fire alarm control panel Signaling Line Circuits.

6. Addressable smoke and thermal detectors shall provide dual alarm and power/polling LEDs. Both LEDs shall flash green under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady red illumination by the control panel, indicating that an alarm condition has been detected. If required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED.

7. The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. The panel on a time-of-day basis shall automatically adjust sensitivity.
8. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72.

9. The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Base options shall include a sounder base with a built-in (local) sounder rated at 85 DBA minimum, a relay base and an isolator base designed for Style 7 applications. The system shall also support an intelligent programmable sounder base, the programmable sounder base shall be capable of providing multiple tones based on programming and at a minimum be capable of providing a Temp-4 tone for CO (Carbon Monoxide) activation and a Temp-3 tone for fire activations and be capable of being synchronized with other programmable sounder bases and common area notification appliances; 85 DBA minimum.

10. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).

11. Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.

12. Addressable devices shall store an internal identifying code that the control panel shall use to identify the type of device.

13. A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100% of the alarm threshold.

14. Addressable modules shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box. An optional surface mount Lexan enclosure shall be available.

B. Addressable Manual Fire Alarm Box (manual station)

1. Addressable manual fire alarm boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module

status; They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.

2. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.

3. Manual fire alarm boxes shall be constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches (44 mm) or larger.

C. Intelligent Photoelectric Smoke Detector: The intelligent photoelectric smoke detector shall be and shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

D. Intelligent VIEW® Laser Photo Smoke Detector: The intelligent laser photo smoke detector shall be a spot type detector, that incorporates an extremely bright laser diode and an integral lens that focuses the light beam to a very small volume near a receiving photo sensor. The scattering of smoke particles shall activate the photo sensor.

1. The laser detector shall have conductive plastic so that dust accumulation is reduced significantly.

2. The intelligent laser photo detector shall have nine sensitivity levels and be sensitive to a minimum obscuration of 0.02 percent per foot.

3. The laser detector shall not require expensive conduit, special fittings or PVC pipe.

4. The intelligent laser photo detector shall support standard, relay, isolator and sounder detector bases.

5. The laser photo detector shall not require other cleaning requirements than those listed in NFPA 72. Replacement, refurbishment or specialized cleaning of the detector head shall not be required.
6. The laser photo detector shall include two bicolor LEDs that flash green in normal operation and turn on steady red in alarm.

E. Intelligent Ionization Smoke Detector: The intelligent ionization smoke detector shall use the dualchamber ionization principal to measure products of combustion and shall, on command from the control panel, send data to the panel representing the analog level of products of combustion.

F. Intelligent Multi Criteria Acclimating Detector: The intelligent multi-criteria Acclimate® $Plus^{TM}$ detector shall be an addressable device, that is designed to monitor a minimum of photoelectric and thermal technologies in a single sensing device. The design shall include the ability to adapt to its environment by utilizing a built-in microprocessor to determine its environment and choose the appropriate sensing settings. The detector design shall allow a wide sensitivity window, no less than 1 to 4% per foot obscuration. This detector shall utilize advanced electronics that react to slow smoldering fires and thermal properties all within a single sensing device.

> 1. The microprocessor design shall be capable of selecting the appropriate sensitivity levels based on the environment type it is in (office, manufacturing, kitchen etc.) and then have the ability to automatically change the setting as the environment changes (as walls are moved or as the occupancy changes).

> 2. The intelligent multi criteria detection device shall include the ability to combine the signal of the thermal sensor with the signal of the photoelectric signal in an effort to react hastily in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a false alarm condition by examining the characteristics of the thermal and smoke sensing chambers and comparing them to a database of actual fire and deceptive phenomena.

G. Intelligent Thermal Detectors: The intelligent thermal detectors shall be NOTIFIER FST- series addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. A high heat thermal detector rated at 190 degrees Fahrenheit shall also be available. The thermal detectors shall connect via two wires to the fire alarm control panel signaling line circuit.

H. Intelligent Duct Smoke Detector: The smoke detector housing shall accommodate an intelligent photoelectric detector that provides continuous analog monitoring and alarm verification from the panel.

When sufficient smoke is sensed, an alarm signal is initiated at the FACP, and appropriate action taken to change over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system. The Intelligent Duct Smoke Detector shall support the installation of addressable Photoelectric detector capable or being tested remotely. The Intelligent Duct Detector housing shall be model # DNR(W) and the remote test capable photoelectric smoke detector shall be NOTIFIER model # FSP-851R.

I. IntelliQuadTM Advanced Multi-Criteria Intelligent Detector

1. Intelligent multi-criteria fire detector shall be a NOTIFIER model number FSC-851. Smoke detector shall be an addressable intelligent multi-criteria smoke detector. The detector shall be comprised of four sensing elements, including a photoelectric (light-scattering) particulate sensor, an electrochemical carbon monoxide (CO) sensor, a daylight-filtered infrared sensor and solid state thermal sensor(s) rated at 135°F (57.2°C). The device shall be able to indicate distinct smoke and heat alarms.

2. The intelligent multi-criteria detection device shall include the ability to combine the signal of the photoelectric signal with other sensing elements in an effort to react quickly in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a nuisance alarm condition. The product design shall be capable of selecting the appropriate sensitivity levels based on the environment type chosen by user in which it is installed (office, manufacturing, kitchen etc.) and then have the ability to automatically change the setting as the environment changes.

3. The detector shall be capable of automatically adjusting its sensitivity by means of drift compensation and smoothing algorithms. The detector shall be capable of automatically adjusting its sensitivity by means of drift compensation and smoothing algorithms. The device shall provide unique signals to indicate when 20% of the drift range is remaining, when 100% of drift range is used, and when there is a chamber fault to show unit requires maintenance.

4. The detector shall indicate CO trouble conditions including 6 months of sensor life remaining and sensor life has expired. The detector shall indicate a combined signal for any of the following: low chamber trouble, thermistor trouble, CO self test failure, IR self test failure, and freeze warning.

5. The detectors shall provide address-setting means on the detector head using rotary switches. Because of the possibility of installation error, systems that use binary jumpers or DIP switches to set the detector address are not acceptable. The detectors shall also store an internal identifying code that the control panel shall use to identify the type of detector. Systems that require a special programmer to set the detector address (including temporary connection at the panel) are labor intensive and not acceptable. Each detector occupies any one of at least 99 possible addresses on the signaling line circuit (SLC) loop. It responds to regular polls from the system and reports its type and status.

6. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a switch) or initiated remotely on command from the control panel. There are three test methods: functional magnet, smoke entry aerosol, or direct heat method.

7. The detectors shall provide two LEDs to provide 360° visibility. The LEDs are placed into steady red illumination by the control panel indicating that an alarm condition has been detected. An output connection shall also be provided in the base to connect an external remote alarm LED, sounder base, and / or relay base (optional accessories). The external remote alarm can be interconnected to other sounder or relay bases for activating all devices in a space via a single alarming unit.

8. Two LEDs on the sensor are controlled by the panel to indicate sensor status. Coded signals, transmitted from the panel, can cause the LEDs to blink, latch on, or latch off. Refer to the control panel technical documentation for sensor LED status operation and expected delay to alarm.

9. The detectors shall be ceiling-mount and shall be plug-in mounted into a twist-lock base. These detectors shall be constructed of off-white UV resistant polymer and shall be detachable from the mounting base to simplify installation, service and maintenance. Mounting base wiring connections shall be made by means of SEMS screws. The detector shall allow pre-wiring of the base and the head shall be a plug-in type. Mounting base shall be mounted on junction box which is at least 1.5 inches (3.81 cm) deep. Mounting base shall be available to mount to standard junction boxes. Suitable boxes include:

- 19 a. 4.0" (10.16 cm) square box with and without plaster ring.
- 20 b. 4.0" (10.16 cm) octagonal box.
- 21 c. 3.5" (8.89 cm) octagonal box.
- 22 d. Single-gang box.
- 10. Meets Agency Standards
- 23 a. ANSI/UL 268 -Smoke Detectors for Fire Alarm Signaling Systems
- 24 b. CAN/ULC-S529- Smoke Detectors for Fire Alarm Systems
- 25 c. FM 3230-3250- Smoke Actuated Detectors for Automatic Fire Alarm Signaling
- J. IntelliQuadTM PLUS Advanced Multi-Criteria Intelligent Fire/CO Detector

1. Advanced Multi-Criteria Fire/CO detector shall be NOTIFIER model # FCO-851 and shall be an addressable advanced multi-criteria smoke detector with a separate signal for carbon monoxide (CO) detection per UL 2075 standards.

2. The detector shall be comprised of four sensing elements, including a photoelectric (light-scattering) particulate sensor, an electrochemical CO sensor, a daylight-filtered infrared (IR) sensor and solid state thermal sensor(s) rated at 135°F (57.2°C). The device shall be able to indicate distinct smoke and heat alarms.

3. The advanced multi-criteria detection device shall include the ability to combine the signal of the photoelectric signal with other sensing elements in order to react quickly in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a nuisance alarm condition. The detector shall be capable of selecting the appropriate sensitivity levels based on the environment type (office, manufacturing, kitchen, etc.) in which it is installed, and then have the ability to automatically change the setting as the environment changes.

4. The CO detector component shall be capable of a functional gas test using a canned test agent to test the functionality of the CO sensing cell.

5. The detector shall be capable of automatically adjusting its sensitivity by means of drift compensation and smoothing algorithms. The device shall provide unique signals to indicate when 20 percent of the drift range is remaining, when 100 percent of drift range is used, and when there is a chamber fault to show the unit requires maintenance.

6. The detector shall indicate CO trouble conditions, including six months of sensor life remaining and sensor life has expired. The detector shall indicate a combined signal for any of the following: low chamber trouble, thermistor trouble, CO self test failure, IR self test failure, and freeze warning.

7. The detector shall provide address-setting means on the detector head using rotary switches. Because of the possibility of installation error, systems that use binary jumpers or DIP switches to set the detector address are not acceptable. The detector shall also store an internal identifying code that the control panel shall use to identify the type of detector. Systems that require a special programmer to set the detector address (including temporary connection at the panel) are labor intensive and not acceptable. Each detector occupies any one of at least 159 possible addresses on the signaling line circuit (SLC) loop. It responds to regular polls from the system and reports its type and status.

8. The detector shall provide a test means whereby it will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a switch) or initiated remotely on command from the control panel. There shall be four test methods: functional magnet, smoke entry aerosol, carbon monoxide aerosol or direct heat method.

9. The detector shall provide two LEDs to provide 360° visibility. The LEDs shall be placed into steady red illumination by the control panel indicating that an alarm condition has been detected. An output connection shall also be provided in the base to connect an external remote alarm LED. The detector must be capable of connecting to a sounder base that provides both temporal 3 and temporal 4 patterns for fire and CO alarm.

10. Two LEDs on the sensor shall be controlled by the panel to indicate sensor status. Coded signals, transmitted from the panel, shall cause the LEDs to blink, latch on, or latch off. Refer to the

control panel technical documentation for sensor LED status operation and expected delay to alarm. 11. The detector shall be plug-in mounted into a twist-lock base. The detector shall be constructed of off-white, UV-resistant polymer and shall be detachable from the mounting base to simplify installation, service and maintenance. Mounting base wiring connections shall be made by means of SEMS screws. The detector shall allow pre-wiring of the base and the head shall be a plug-in type. The mounting base shall be mounted on a junction box that is at least 1.5 inches (3.81 cm) deep. The mounting base shall be available to mount to standard junction boxes. Suitable boxes include:

- a. 4.0" (10.16 cm) square box with and without plaster ring.
- 27 b. 4.0" (10.16 cm) octagonal box.
- 28 c. 3.5" (8.89 cm) octagonal box.
- 29 d. Single-gang box.
- 30 e. Double-gang box
- 12. Meets Agency Standards

31	a.	ANSI/UL 268 -Smoke Detectors for Fire Alarm Signaling Systems
32	b.	CAN/ULC-S529- Smoke Detectors for Fire Alarm Systems
33	с.	FM 3230-3250- Smoke Actuated Detectors for Automatic Fire Alarm Signaling
34	d.	UL 2075 – Gas and Vapor Detector and Sensors – Systems Connected

K. Intelligent Addressable Aspiration Detector: The intelligent aspiration detector shall be NOTIFIER model # FSA-8000 an addressable aspiration detector that communicates directly with the fire alarm control panel via the SLC communication protocol, no modules or high level interfaces shall be required. The fire alarm control panel shall support up to thirty one intelligent aspiration detectors per SLC loop. The aspiration detector shall have dual source (blue LED and infra-red laser) optical smoke detection for a wide range of fire detection with enhanced immunity to nuisance particulates. The FACP shall be capable of monitoring and annunciating up to five smoke event thresholds and eleven trouble conditions. Each event threshold shall be capable of being assigned a discrete type ID at the FACP.

L. Intelligent Addressable Reflected Beam Detector

1. The intelligent single-ended reflected beam smoke detector shall connect with two wires to the fire alarm control panel signaling line circuit (SLC). The detectors shall consist of a transmitter/receiver unit and a reflector and shall send data to the panel representing the analog level of smoke density. The detector shall be capable of being tested remotely via a keyswitch; NOTIFIER model # FSB-200. Model # FSB-200S shall be equipped with an integral sensitivity test feature.

M. Addressable Dry Contact Monitor Module

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to one of the fire alarm control panel SLCs. The addressable monitor module shall be NOTIFIER model # FMM-1 (Class A or B) or FMM-101 (Class B)

2. The IDC zone shall be suitable for Style D/Class A or Style B/Class B operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

3. For difficult to reach areas, the monitor module shall be available in a miniature package and shall be no larger than 2-3/4 inch (70 mm) x 1-1/4 inch (31.7 mm) x 1/2 inch (12.7 mm). This version need not include Style D or an LED.

4. For multiple dry contact monitoring a module shall be available that provides 10 Style B or 5 Style D input circuits; NOTIFIER model # XP10-M.

N. Two Wire Detector Monitor Module

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device);

NOTIFIER model # FZM-1.

2. The IDC zone may be wired for Class A or B (Style D or Style B) operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

3. For multiple 2-wire smoke detector circuit monitoring a module shall be available that provides 6 Style B/Class A or 3 Style D/Class B input circuits; NOTIFIER model # XP6-MA.

O. Addressable Control Module

1. Addressable control modules shall be provided to supervise and control the operation of one conventional circuit of compatible Notification Appliances, 24 VDC powered, polarized audio/visual notification appliances; NOTIFIER model # FCM-1

2. The control module NAC may be wired for Style Z or Style Y (Class A/B) with a current rating of 2 Amps for Style Z and 3 Amps for Style Y;

3. Audio/visual power shall be provided by a separate supervised circuit from the main fire alarm control panel or from a supervised UL listed remote supply.

4. For multiple circuit control a module shall be available that provides 6 Style Y (Class B) or 3 Style Z (Class A) control circuits; NOTIFIER model # XP6-C.

P. Addressable Releasing Control Module

1. An addressable FlashScan releasing module shall be available to supervise and control compatible releasing agent solenoids; NOTIFIER model # FCM-1-REL.

2. The module shall operate on a redundant protocol for added protection.

3. The module shall be configurable for Style Z or Style Y (Class A/B) and support one 24 volt or two 12 volt solenoids.Add FMM-4-20

- Q. Addressable 4-20 mA module shall be available to monitor industry-standard, linear-scale, 4-20 mA protocol sensors. The module converts the sensor output to communication protocol that can be interpreted by the FACP for monitoring and display; NOTIFIER model # FMM-4-20.
 - 1. The module shall support programming of up to five programmable event thresholds.

2. The System shall be FM 6320 (Factory Mutual) approved as a Gas Detection system when employed with the FMM-4-20 monitor module and industry standard 4-20 mA gas detectors.

R. Addressable Relay Module:

1. Addressable Relay Modules shall be available for HVAC control and other network building functions; NOTIFIER model # FRM-1.

2. The module shall provide two form C relays rated at up to 3 Amps resistive and up to 2.0 Amps inductive.

3. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary devices energize at the same time on the same pair of wires;

- 4. For multiple relay control a module shall be available that provides 6 programmable Form-C relays; NOTIFIER model # XP6-R.
- S. Addressable Two-In / Two-Out Monitor/Relay Module:

An addressable Two-In / Two-Out module shall be available; NOTIFIER model # FDRM-1.
 The two-in/two-out module shall provide two Class B/Style B dry-contact input circuits and

two independent Form-C relays rated at up to 3 Amps resistive and up to 2.0 Amps inductive.

- T. Isolator Module: Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC Class A or Class B branch. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop segment or branch. At least one isolator module shall be provided for each floor or protected zone of the building; NOTIFIER model # ISO-X.
 - 1. If a wire-to-wire short occurs, the isolator module shall automatically open-circuit

(disconnect) the SLC. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section.

2. The isolator module shall not require address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.

3. The isolator module shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

U. Serially Connected Annunciator Requirements

1. The annunciator shall communicate to the fire alarm control panel via an EIA 485 (multi-drop) two-wire communications loop. The system shall support two 6,000 ft. EIA-485 wire runs. Up to 32 annunciators, each configured up to 96 points, may be connected to the connection, for a system capacity of 3,072 points of annunciation.

2. An EIA-485 repeater shall be available to extend the EIA-485 wire distance in 3,000 ft. increments. The repeater shall be UL864 approved.

3. Each annunciator shall provide up to 96 alarm and 97 trouble indications using a long-life programmable color LED's. Up to 96 control switches shall also be available for the control of Fire Alarm Control Panel functions. The annunciator will also have an "ON-LINE" LED, local piezo sounder, local acknowledge and lamp test switch, and custom zone/function identification labels.

4. The annunciator may be field configured to operate as a "Fan Control Annunciator". When configured as "Fan Control," the annunciator may be used to manually control fan or damper operation and can be set to override automatic commands to all fans/dampers programmed to the annunciator.

Annunciator switches may be programmed for System control such as, Global Acknowledge, Global Signal Silence, Global System Reset, and on/off control of any control point in the system.
 An optional module shall be available to utilize annunciator points to drive EIA-485 driven

relays. This shall extend the system point capacity by 3,072 remote contacts.

7. The LED annunciator shall offer an interface to a graphic style annunciator and provide each of the features listed above.

V. SpectrAlert Advance Speakers

1. The Speaker appliance shall be System Sensor SpectrAlert Advance model _____ Speaker. The speaker shall be listed to UL 1480 for Fire Protective Signaling Systems. It shall be a dual-voltage transformer speaker capable of operation at 25.0 or 70.7 nominal Vrms. The speaker shall have a frequency range of 400 to 4,000 Hz and shall have an operating temperature between 32°F and 120°F. It shall mount to a 4 x 4 x 2 1/8-inch back box.

2. A universal mounting plate shall be used for mounting ceiling and wall speaker products. The notification appliance circuit and amplifier wiring shall terminate at the universal mounting plate.

3. Speakers shall be plug-in and shall have the ability to check wiring continuity via a shorting spring on the universal mounting plate. The shorting spring shall also provide tamper resistance via an open circuit if the device is removed. Speaker design shall isolate speaker components to reduce ground fault incidents.

4. The speaker shall have power taps (from ¹/₄ watt to 2 watts) and voltage that are selected by rotary switches. All models shall have a maximum sound output of 86 dB at 10 feet and shall incorporate an open back construction.

5. All notification appliances shall be backward compatible.

Ceiling Speaker

Wall Speaker

Wide Band Frequency Response

Wide Band Frequency Response



W. SpectrAlert Advance Speaker Strobes

1. The Speaker Strobe appliance shall be System Sensor SpectrAlert Advance SPS and SPV series Speaker Strobe. The speaker strobe shall be listed to UL 1971 and UL 1480 and be approved for fire protective signaling systems. It shall be a dual-voltage transformer speaker strobe capable of operation at 25.0 or 70.7 nominal Vrms. The speaker shall have a frequency range of 400 to 4,000 Hz and shall have an operating temperature between 32° F and 120° F. It shall mount to a 4 x 4 x 2 1/8-inch back box.

2. A universal mounting plate shall be used for mounting ceiling and wall speaker strobe products. The notification appliance circuit and amplifier wiring shall terminate at the universal mounting plate. Also, SpectrAlert Advance speaker strobes and the Sync•Circuit[™] Module MDL3 accessory, if used, shall be powered from a non-coded notification appliance circuit output and shall operate on a nominal 12 or 24 volts (includes fire alarm panels with built in sync). When used with the Sync•Circuit Module MDL3, 12-volt rated notification appliance circuit outputs shall operate between 8.5 and 17.5 volts; 24-volt rated notification appliance circuit outputs shall operate between 16.5 to 33 volts. If the notification appliances are not UL 9th edition listed with the corresponding panel or power supply being used, then refer to the compatibility listing of the panel to determine maximum devices on a circuit.

3. Speaker strobes shall be plug-in and shall have the ability to check wiring continuity via a shorting spring on the universal mounting plate. The shorting spring shall also provide tamper resistance via an open circuit if the device is removed. Speaker strobe design shall isolate speaker components to reduce ground fault incidents.

4. The speaker strobe shall have power taps (from ¼ watt to 2 watts) and voltage that are selected by rotary switches. All models shall have a maximum sound output of 86 dB at 10 feet and shall incorporate an open back construction. The strobe shall consist of a xenon flash tube with associated lens/reflector system and operate on either 12V or 24V. The strobe shall also feature selectable candela output, providing options for 15 or 15/75 candela when operating on 12V and 15, 15/75, 30, 75, 110, or 115 when operating on 24V. The strobe shall comply with NFPA 72 and the Americans with Disabilities Act requirement for visible signaling appliances, flashing at 1 Hz over the strobe's entire operating voltage range.

5. All notification appliances shall be backward compatible.

Ceiling Speaker Strobe

Wall Speaker Strobe

Wide Band Frequency Response





6. Strobe lights shall meet the requirements of the ADA, UL Standard 1971and be fully synchronized.

X. FIRE ALARM CABLE

1

- The fire alarm cable shall plenum rated and be UL listed and suitable for use as power limited fire protective signaling circuit cable in accordance with National Electric Code Article 760 (Fire Alarm Systems) and Article 725 (Class 1, Class 2 and Class 3 Remote Control, Signaling and Power-Limited Circuits).
- A. Cable Construction
 - 1 Conductors shall be solid, soft annealed, uncoated copper.
 - 2 Insulation shall be 300 volt, 105°C polyvinylchloride.
 - 3 Two conductor, non-shielded cables shall be parallel; shielded and three or more conductors shall be cabled round.
 - 4 Shielding shall be mylar backed aluminum foil, helically wrapped to provide 100% coverage. A suitable copper drain wire shall be provided with shielded cables.
 - 5 Jacket shall be red, 105°C polyvinylchloride, rated 300 volt.
 - 6 Cable shall be plenum rated when installed in air handling plenums.
- B. In general, non-shielded cable is acceptable for use throughout except on voice circuits. All voice circuits shall utilize shielded, twisted pair cable.

PART 3.0 - EXECUTION

3.1. INSTALLATION:

A. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.

B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

C. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.

D. Manual fire alarm boxes shall be suitable for surface mounting or semi-flush mounting as shown on the plans, and shall be installed not less than 42 inches (1067 mm), nor more than 48 inches (122 mm) above the finished floor.

3.2. TEST:

The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72.

A. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.

- B. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.
- C. Verify activation of all waterflow switches.
- D. Open initiating device circuits and verify that the trouble signal actuates.
- E. Open and short signaling line circuits and verify that the trouble signal actuates.
- F. Open and short notification appliance circuits and verify that trouble signal actuates.
- G. Ground all circuits and verify response of trouble signals.
- H. Check presence and audibility of tone at all alarm notification devices.
- I. Check installation, supervision, and operation of all intelligent smoke detectors using the walk test.

J. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.

K. When the system is equipped with optional features, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

3.3. FINAL INSPECTION:

A. At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall demonstrate that the system functions properly in every respect.

3.4. INSTRUCTION:

A. Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.

B. The contractor and/or the systems manufacturer's representatives shall provide a typewritten "Sequence of Operation."

END OF SECTION